INSTRUCTION MANUAL

for

DIGITAL TONE BURST-TIMING GENERATOR

SERIES 206

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SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual provides operating and service instructions for the Digital Tone Burst-Timing Generator Series 206 (hereinafter referred to as Model 206), manufactured by Dranetz Engineering Laboratories, Incorporated. This section discusses the purpose, application, technical characteristics, and physical description of Model 206.

1-3. Sections I through VI of this manual apply specifically to Model 206. Operation and maintenance instructions for Model 206A are the same as those covered for Model 206 except for the remote programming option used on Model 206A only. The model differences will be noted as they occur.

1-4. PURPOSE.

1-5. Model 206 (figure 1-1) is used to gate the output of an a-c signal generator to produce either a single signal burst or repetitive signal bursts, with turn-on and turn-off times coincident with zero crossings of the signal to minimize switching transients. Internal or external triggering is provided to initiate an accurate sequence of pulses for: turning on the signal at its first positive going zero crossing, turning off the signal at the first positive going zero crossing following a precise time interval, triggering of oscilloscopes or other devices, and gating detectors or receivers after a precise time interval. Model 206A has the added feature of accepting parallel BCD inputs for each of the five timing controls (4 digits each) at rear connectors (BCD Code 8421).

1-6. APPLICATIONS.

1-7. Model 206 can be used in the following areas:

a. Automatic AC testing of electronic component and circuits.

b. Calibration of underwater transducers under tone burst conditions.

c. Measurement of propagation and reflections in acoustical fields.

d. Testing of data communications systems or equipments such as modems, multiplexers and switching circuits.

Figure 1-1. Digital Tone Burst-Timing Generator Series 206

1-8. EQUIPMENT CHARACTERISTICS.

1-9. Table 1-1 provides the technical characteristics for Model 206.

1-10. PHYSICAL DESCRIPTION.

1-11. Model 206 is a rectangular shaped unit with a front and rear panel. The front panel contains various switches, controls, and connectors necessary to operate Model 206. The rear panel provides the connectors used for input and output signal connection. The five connectors located on the right side of the rear panel are used on Model 206A when the remote programming option is employed.

1-12. Model 206 can be bench or rack-mounted. For mounting in a standard 19-inch rack, the side plates are reversed. Outer dimensions and the weight of Model 206 is provided in table 1-1.

Table 1-1. Technical Characteristics

Type	Specifications
MODES OF OPERATION	CW (Continuous Wave) Repetitive tone burst internally triggered Externally triggered tone burst. Single tone burst
SIGNAL CHANNEL	
Frequency range:	50 Hz to 3 mHz
Input level:	Sinusoidal signal, 1 volt rms ±10%
Input impedance:	Approximately 10 kilohms shunted by 100 pf maximum
Output level:	Adjustable from 0.1 to 1 volt rms into 75 ohm load over full frequency range; adjustable from 0.5 to 5 volts rms into 10 kilohm load at frequencies up to 2 mHz.
Output distortion:	Less than 1/2% from 50 Hz to 0.5 mHz; less than 1% to 3 mHz.
Input to output isolation:	Greater than 60 db to 0.5 mHz; noise typically 60 db down from full scale output.

Table 1-1. Technical Characteristics (Cont)

Type	Specifications
Types of gating (selectable by operator):	Zero crossing turn on and zero crossing turn off; less than 1.5° or 25 nanoseconds coincidence error (60 Hz line synchronous lock selectable by operator). Non-synchronous turn-on and turn-off.
TIMING CONTROL	
All timing is controlled by a master crystal oscillator, with count-down circuits for each timing function. Each function is selectable by an individual direct-reading four (4) digit thumbwheel switch on the front panel. A time multiplier switch which multiplies all time settings simultaneously by 1, 10, or 100 is also provided. *The controlled timing function of the Digital Tone Burst-Timing Generator is remotely programmable using the Model 206A.	
Repetition period:	100 microseconds to 99.99 seconds.
Transmitting pulsewidth:	10 microseconds to 9.999 seconds.
Transient delay pulse:	10 microseconds to 9.999 seconds.
Receiver delay:	10 microseconds to 9.999 seconds.
Receiver on time (gate width):	10 microseconds to 9.999 seconds.
EXTERNAL TRIGGER	Pulse or square wave input, ±5 volts into 3 kilohm load, transformer input, rise time 50 microseconds maximum, duration 50 microseconds minimum.
OUTPUT CONTROL PULSES	
Sync Output:	+5 volt pulse at transmitter turn-on followed by -5 volt pulse for delayed receiver turn-on; rise time less than 50 microseconds, transformer coupled, output impedance 6 kilohms.
Transmitting gate output (for use with commercial E-I Normalizers):	+10 volt rectangular wave, having leading edge coincident with transmitter turn-on and lagging edge coincident with transmitter turn-off; rise and fall times less than 1 microsecond, output impedance 350 ohms.

Table 1-1. Technical Characteristics (Cont)

Type	Specifications
Transient delay output:	+10 volt rectangular wave having lagging edge coincident with setting of Transient Delay control; rise and fall times less than 1 microsecond, output impedance 350 ohms.
Receiver delay and on-time control:	+10 volt rectangular wave having leading edge corresponding to receiver Delay Control, and pulse width corresponding to Receiver On-time Control; rise and fall times less than 1 microsecond, output impedance 350 ohms.
NOTE Current is limited to approximately 5 ma on Output Control Pulses: Sync, Transmitting Gate and Transmitting Transient Delay. For driving +5 vdc CSL modules, shunt these outputs with 4.3 volt Zener diodes (IN 749 or equivalent).	
INPUT POWER	105-125V, 50-60 Hz, 40 watts
GROUNDING	Separate chassis, circuit and power line grounds to minimize problems of ground loops.
DIMENSIONS	3-1/2" High x 17" Wide x 16" Deep in MR11 case. (MR11 case is equipped with hardware for mounting in standard 19" relay rack. For rack mounting, remove four (4) screws on each side and reverse side plates.)
SHIPPING WEIGHT	30 pounds
UNPACKAGED WEIGHT	20 pounds

*Remote Programmable Option (Model 206A)

Parallel BCD (8421) rear panel inputs are provided for each timing control. Remote operation on zero position of manual controls (one for 0 to +0.8 vdc, zero for +2 to +5 vdc).

Remote control by switch closure should have minimum rating of 3.2 ma DC.

SECTION II

INSTALLATION

2-1. GENERAL.

2-2. This section contains the installation procedures for Model 206. All data required to prepare the Model 206 for operational use as well as mounting instructions are provided in the following paragraphs.

2-3. UNPACKING.

2-4. Upon receipt of the shipping container place on a stable flat surface. Note any cautions or warnings, located on the shipping container, to be observed before unpacking. Carefully remove the packing material so as not to damage outer surfaces, controls, panels or the case assembly. Retain all packing material and the shipping container for possible storage or reshipment of the Model 206.

2-5. PREPARATION FOR USE.

2-6. Preparing the Model 206 for operation requires a minimum performance check (paragraph 5-13) to insure that damage to the equipment has not occurred during shipment. In addition to a minimum performance check, visually inspect the Model 206 for the following:

a. Chips, scratches, rust or bare metal exposed on painted surfaces. Touch up painted areas where necessary.

b. Bent pins or other damage to external connectors.

c. Looseness of external items such as an indicator lamp, switches, and connectors. Tighten as required.

d. Gain access to Model 206 by removing chassis assembly from the case (paragraph 5-7) to check that printed circuit cards or chassis-mounted components are rigidly in place. Do not rock or twist to check; use only direct pressure to ensure that item is firmly seated. Tighten as required.

2-7. MOUNTING.

2-8. Model 206 can be operated either on a bench or mounted in a standard 19-inch rack. Figure 2-1 illustrates the outer dimensions of Model 206. For bench operation, make the proper signal and power connections. To mount the Model 206 into a rack, proceed as follows:

a. Remove screws securing both side plates to the case assembly.

b. Reinstall the side plates so that the ends with the two U-shaped slots are facing forward and away from the front panel.

c. Slide the Model 206 into the rack until the side plate mounting holes line up with their respective mounting holes in the rack.

d. Secure the Model 206 to the rack using four screws.

e. Connect the necessary signal and power cables to the connectors located at the rear panel. Refer to paragraph 2-9 for the external power requirements.

2-9. EXTERNAL POWER REQUIREMENTS.

2-10. The required input power for Model 206 operation is 115 ± 10 volts, 50-60 Hz at 40 watts. Power to the Model 206 is provided via connector marked A.C. PWR located on the rear panel.

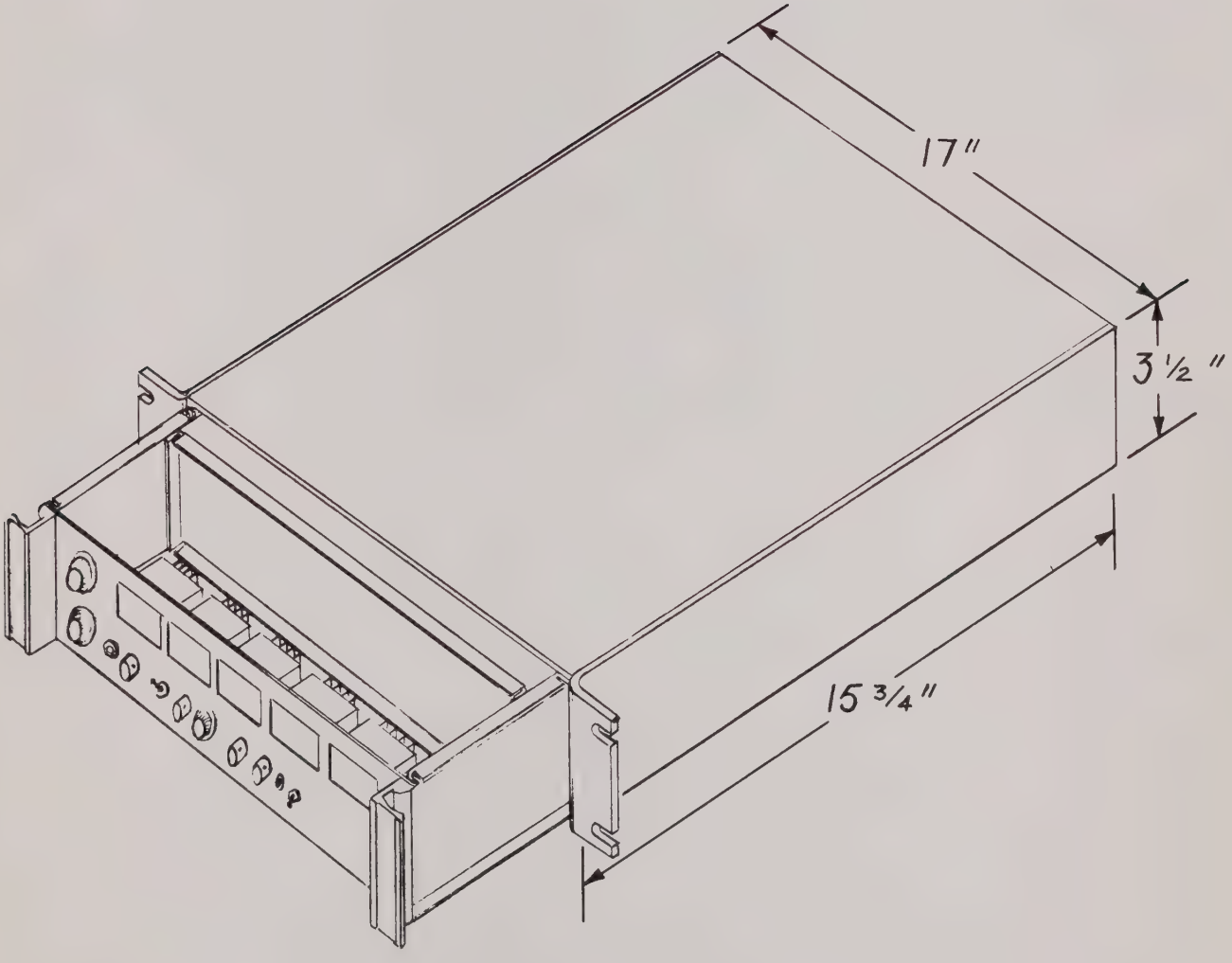


Figure 2-1. Model 206, Dimensional Outline Drawing

SECTION III

OPERATION

3-1. GENERAL.

3-2. This section contains the operating procedures for the Model 206. Operating controls, connectors and indicator are referred to by the nomenclature that appears on the front and rear panels, in uppercase letters. In addition to panel nomenclature, preliminary operation and operating procedures are also provided in subsequent paragraphs.

3-3. CONTROLS, CONNECTORS AND INDICATOR.

3-4. Figure 3-1 illustrates the front panel operating controls, connectors and indicator for Models 206 and 206A. This illustration is supported by table 3-1 which lists the index number, reference designation and function of those items called out in the figure. Figure 3-2 illustrates the rear panel of Model 206A. The difference between Models 206 and 206A is index numbers 7 through 11 which are used on the Model 206A only. This illustration is supported by table 3-2.

3-5. PRELIMINARY OPERATION.

3-6. To prepare Model 206 for operation, proceed as follows:

a. Check that Model 206 is properly connected to 105-125 volt, 50-60 Hz, 40 watts power.

b. Check that all grounds at the rear panel are connected.

c. Set POWER switch on the front panel to the off (down) position.

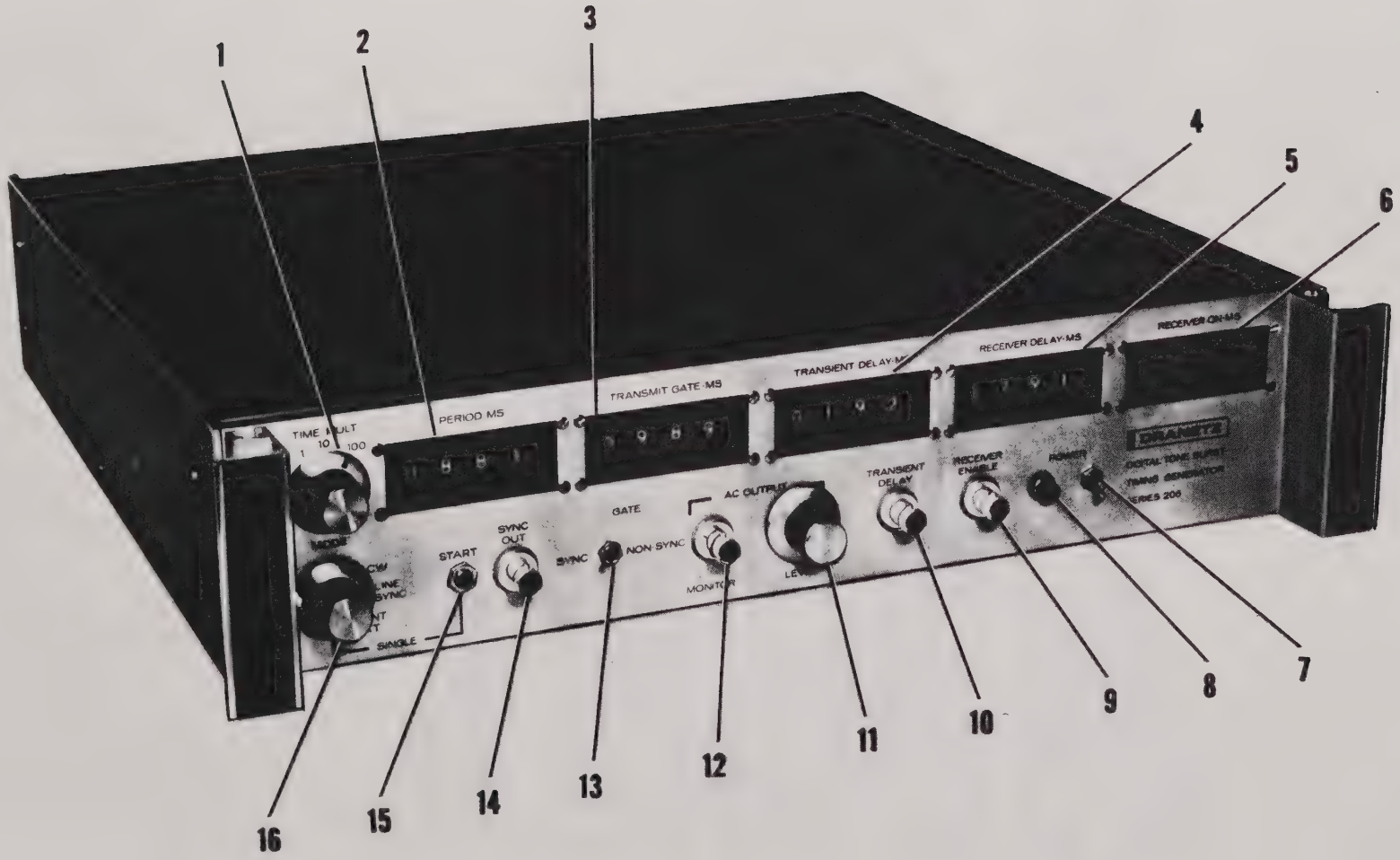


Figure 3-1. Front Panel Operating Controls, Indicator and Connectors

Table 3-1. Front Panel Operating Controls, Indicator and Connectors

Fig. 3-1 Index No.	Ref Des	Control Indicator or Connector	Function
1	S7	TIME MULT 1, 10, 100 switch	Multiplies the times indicated by the TRANSMIT GATE-MS, TRANSIENT DELAY-MS, RECEIVER DELAY-MS, RECEIVER ON-MS and PERIOD-MS switches by the factor indicated.
2	S5	PERIOD-MS switch	Sets the period, for repetitive modes, from .1 ms to 999.9 ms in .1 ms steps (TIME MULT at 1).
3	S1	TRANSMIT GATE-MS switch	Sets the transmit gate from .01 to 99.99 ms in .01 ms steps (TIME MULT at 1). For zero crossing sync, the transmit gate turns off at the positive zero crossing that follows this setting.
4	S2	TRANSIENT DELAY-MS switch	Sets the transient delay pulse from .01 ms to 99.99 ms in .01 ms steps (TIME MULT at 1).
5	S3	RECEIVER DELAY-MS switch	Sets the receiver enable delay from .01 ms to 99.99 ms in .01 ms steps (TIME MULT at 1).
6	S4	RECEIVER ON-MS switch	Sets the receiver enable duration from .01 ms to 99.99 ms in .01 ms steps (TIME MULT at 1).
7	S10	POWER switch	Applies power in the on (up) position.
8	I1	POWER indicator	When lit, indicates power is applied.

Table 3-1. Front Panel Operating Controls, Indicator and Connectors (Cont)

Fig. 3-1 Index No.	Ref Des	Control Indicator or Connector	Function
9	J4	RECEIVER ENABLE connector	Provides an enabling pulse for use with sampling voltmeters and other instruments to permit sampling only during the desired interval.
10	J3	TRANSIENT DELAY connector	Provides a delayed rectangular wave to prevent or delay operation of instruments until the desired time.
11	R1	AC OUTPUT LEVEL control	Provides adjustable level of gated ac output.
12	J2	AC OUTPUT MONITOR connector	Signal monitor output.
13	S8	GATE switch SYNC NON-SYNC	In the SYNC position, the AC signal is turned on and off at positive-going zero crossings. In the NON-SYNC position, the AC signal is turned on and off without reference to zero crossings of the AC signal.
14	J1	SYNC OUT connector	Provides synchronizing pulses to synchronize oscilloscopes.
15	S9	START SINGLE pushbutton switch	When MODE switch is in SINGLE mode, each depression of the START SINGLE pushbutton triggers one group of outputs.
16	S6	MODE switch CW LINE SYNC INT EXT SINGLE	Selects desired operating mode.

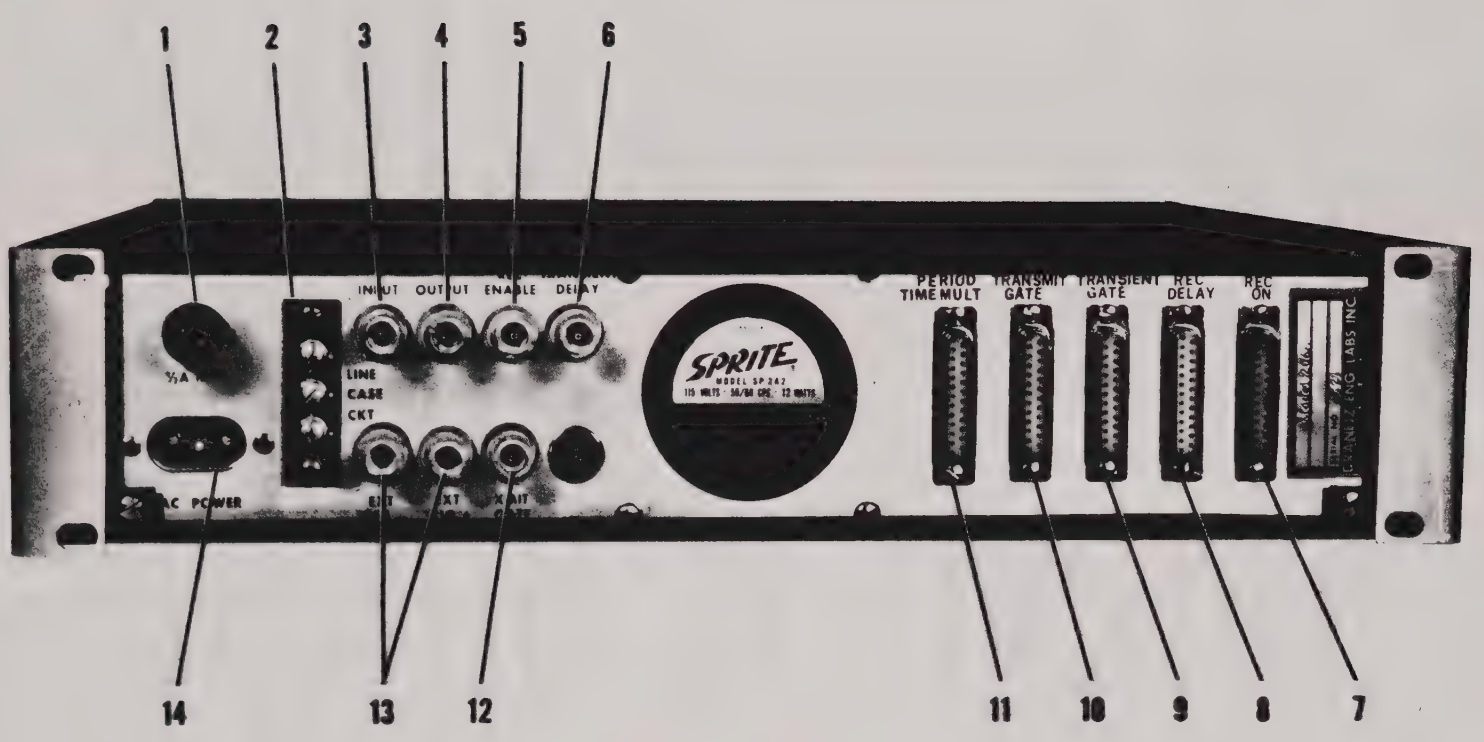


Figure 3-2. Rear Panel Operating Connectors and Fuse

Table 3-2. Rear Panel Operating Connectors and Fuse

Fig. 3-2 Index No.	Ref Des	Fuse or Connector	Function
1	F1	F1 1/2 A MDL fuse	AC line power overload protection.
2	TB1	LINE CASE CKT ground board	A convenience terminal board to facilitate proper connection of grounds.
3	J5	INPUT connector	50 Hz to 3 mHz, 1 volt rms ac source for gated AC output.
4	J6	OUTPUT connector	AC signal gated by transmit gate.
5	J7	REC ENABLE connector	Zero to +10 vdc output during receive interval. This connector is in parallel with index 9, figure 3-1.
6	J8	TRANSIENT DELAY connector	+10 vdc to zero output at setting of TRANSIENT DELAY-MS switch (4, figure 3-1). This connector is in parallel with index 10, figure 3-1.
7*	J16	J16 connector (receiver enable duration)	External programming inputs, BCD (8241). "1" level 0 to +0.8 volt. "0" level 2.0 to 5.0 volts.
8*	J15	J15 connector (receiver delay)	Same as index number 7.
9*	J14	J14 connector (transient delay)	Same as index number 7.
10*	J13	J13 connector (transmit gate duration)	Same as index number 7.
11*	J12	J12 connector (period and time multiplier)	Same as index number 7.

*Used on Model 206A only. These are Cannon DB25S connectors.

Table 3-2. Rear Panel Operating Connectors and Fuse (Cont)

Fig. 3-2 Index No.	Ref Des	Fuse or Connector	Function
12	J11	XMIT GATE connector	Zero to +10 vdc output during AC Gate ON interval.
13	J9 J10	EXT TRIG - connector EXT TRIG + connector	Provides for connection of external trigger pulses when MODE switch is in EXT position.
14	J17	A. C. POWER connector	Provides input connection for ac power line voltage, 3 wire, center pin at power line ground. Use Belden cord set 172585-8 ft., No. 18/3 Type SVT or equivalent.

3-7. OPERATING PROCEDURES.

3-8. The operating procedures provided in this paragraph are the same for Models 206 and 206A except where noted. After performing the preliminary operation described in paragraph 3-5, proceed as follows:

CAUTION

Ground loop problems may arise when using the Model 206 in a rack mounted system. Provision for elimination of such problems is made at TB 1 on the rear panel. When the equipment is rack-mounted, it is usually advisable to remove the jumper connecting LINE, CASE and CKT grounds. The EXT TRIG inputs and the SYNC output are transformer coupled and therefore will not introduce additional ground paths when connected. The shells of all other jacks are directly connected to Model 206 CKT ground.

a. Set the MODE, TIME MULT and timing switches to the desired conditions. For external (EXT) timing, provide an external trigger for each cycle at the rear panel.

NOTE

The PERIOD-MS time setting must be kept greater than all of its component parts. If all timing functions are not completed before the period ends, the unit may not re-cycle correctly.

b. Operate the POWER switch to on (up position). The POWER lamp should light.

c. Connect a source of ac signal from 50 Hz to 3mHz at 1 volt rms for use as the gated transmit signal to the INPUT connector.

d. Adjust the AC OUTPUT LEVEL control to the desired output level. This level can be measured with a VTVM by switching the MODE switch to CW and connecting the VTVM to the AC OUTPUT MONITOR connector. After the level is set, if gated operation is desired, the MODE switch can be reset without changing the output level.

NOTES

1. When operating in the "sync" modes, keep the TRANSMIT GATE-MS time setting plus two periods of signal frequency shorter than the PERIOD-MS setting. Also, do not use TRANSMIT GATE-MS time settings shorter than 30 microseconds.

2. When operating in the EXT mode, keep the TRANSMIT GATE-MS time setting greater than 0.1 ms and also the repetition rate lower than 5 kHz.

3. When switching the Model 206 between times and modes, it is possible for the Model 206 to lockup for the maximum possible time of setting, for example, in the times 100 position 999.99 X 100 ms or 99 sec. When this happens, depress the START SINGLE pushbutton switch (S9) on the front panel. This will cause the Model 206 to resume operation. On Model 206A, a HIGH (5 volt) to LOW (ground) transition on pin 21 of connector J12 will cause Model 206A to resume operation.

3-9. The following operating procedures are used with Model 206A for remote program operation.

a. Set all front panel digital switches to zero.

b. At the rear panel of Model 206A, on connector J12, jumper pins 14 and 16 to pins 15 and 17 respectively. This disables the TIME MULT switch and enables the rear input for external time multiplier selection.

c. Connect +5 vdc CSL logic outputs to J12, pins 18, 19 and 20 driving them to ground. Refer to table 3-2. The control codes for these pins are as follows:

Multiplier	Pin 18	Pin 19	Pin 20
X1	HIGH	LOW	LOW
X10	LOW	HIGH	LOW
X100	LOW	LOW	HIGH
Logic levels are as follows: HIGH is +2 to +5 vdc, LOW is zero to +0.8 vdc.			

d. Refer to table 3-2, index numbers 7, 8, 9, 10, and 11 for logic level definitions and connector identifications regarding the digital switch functions.

e. Circuit closures to ground may be substituted for logic 1 levels (Low) if desired.

f. Pin connections for BCD (8421) inputs are as follows:

Function		Pin No.
Common (ckt ground)		1
1st Digit (most significant)	8	13
	4	12
	2	11
	1	10
2nd Digit	8	9
	4	8
	2	7
	1	6
3rd Digit	8	5
	4	4
	2	3
	1	2
4th Digit (least significant)	8	25
	4	24
	2	23
	1	22

SECTION IV

THEORY OF OPERATION

4-1. GENERAL.

4-2. This section provides a functional description of the Model 206. The description is broken down into four functional areas: timing, counting, comparing, and output gating. In addition to these functions, the timing relationship of the output waveforms is also discussed.

4-3. FUNCTIONAL DESCRIPTION.

4-4. Model 206 consists of four functional groups. These functions are discussed in the subsequent paragraphs and are supported by figure 4-1 the Overall Block Diagram.

4-5. TIMING.

4-6. The crystal clock pulse generator 5A9 provides a 3 mHz square wave which is applied to a divider. The 3 mHz square wave is then divided by three and the resultant output is a 1 mHz square wave. The 1 mHz square wave is applied to the clock processor and to three decade dividers where the square wave is again divided down to provide a 100 kHz, 10 kHz and a 1 kHz signal. The timing signal is selected from these three square waves to produce outputs which are equal to the times set into the front panel thumb-wheel switches and multiplied by the setting (1, 10 or 100) of the TIME MULT switch. The timing signal together with the 1 mHz square wave generate the clock signal in the clock processor. The outputs of the clock processor are trains of 1.0 usec strobe and clock pulses; each train at the selected frequency. The Clock and Strobe outputs are approximately 90 degrees out of phase. When using Model 206A, external inputs via connector J12 together with the selected clock signal are applied to NAND gates 4A1 and 4A2 on circuit card No. 4. The output of circuit card No. 4 is applied to the clock processor to provide the timing signals as described for Model 206.

4-7. COUNTING.

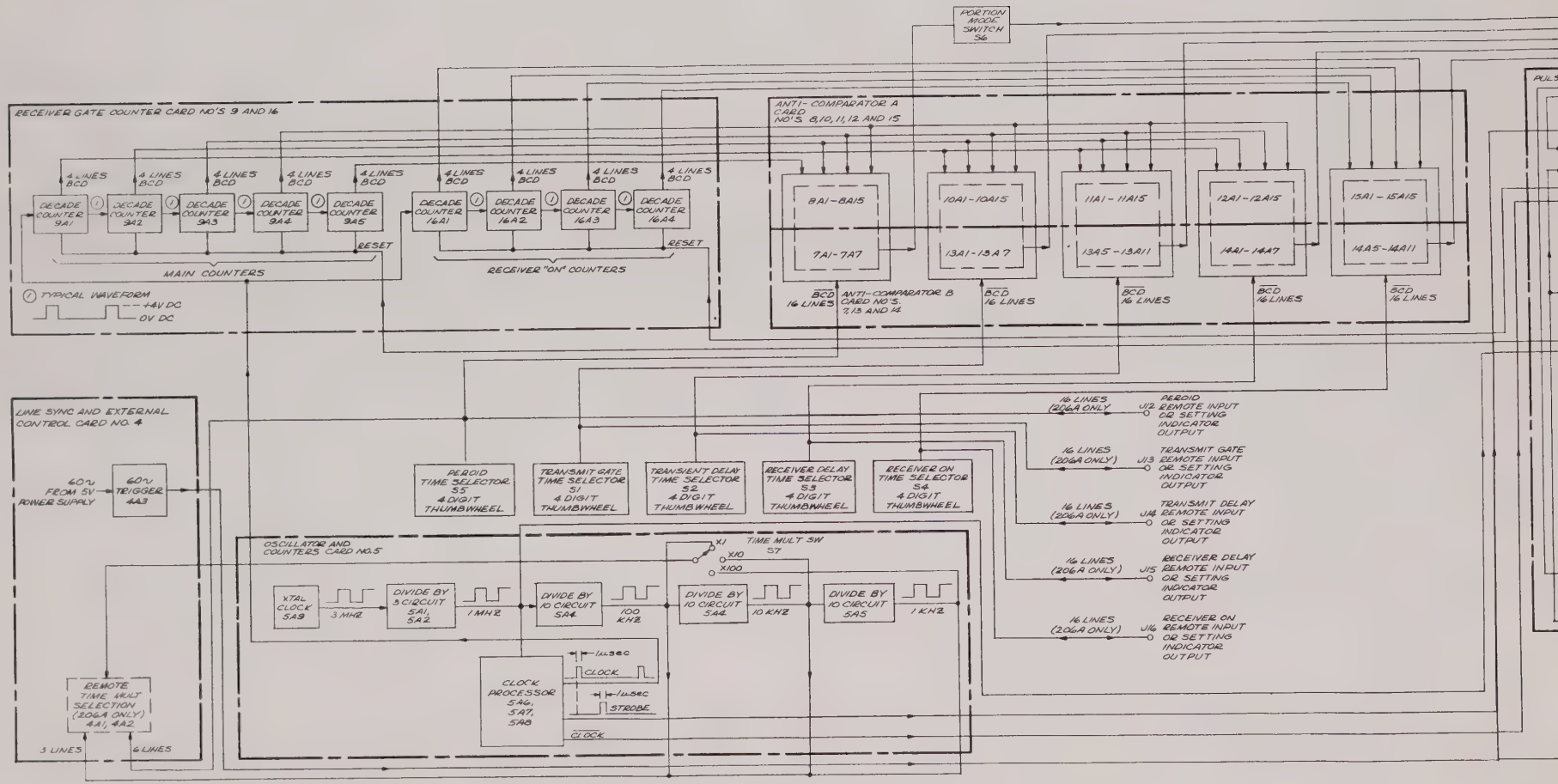
4-8. The Clock output of the clock processor is applied to decade counters 9A1 through 9A5 and 16A1 through 16A4. Each decade is a binary-coded-decimal counter which follows the following sequence:

	Output			
Input	Line 1	Line 2	Line 3	Line 4
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

If the input Clock pulses occur at a 10 usec period, decade counter 9A1 will advance to the next state of the sequence each 10 usec, and will cycle each 10 steps. Output line 1 of each decade counter is used as the input to the next decade counter. Since changes occur on negative transitions of the input to the decade counter, decade counter 9A2 will advance one step each time decade counter 9A1 changes from input 9 to input 10. Thereby decade counter 9A1 records elapsed time in 10 usec steps (with the TIME MULT setting on 1), decade counter 9A2 in 100 usec steps, decade counter 9A3 in 1 msec steps, decade counter 9A4 in 10 msec steps and decade counter 9A5 in 100 msec steps. The maximum recorded time of the five decades is 999.99 msec. The outputs of decade counters 9A1 through 9A5 are applied to four anti-comparators where these outputs are compared with the settings of the four-digit BCD thumbwheel switches. The outputs of decade 16A1 through 16A4 are also applied to an anti-comparator for comparison with the setting of a four-digit thumbwheel switch.

4-9. COMPARING.

4-10. The anti-comparators detect numerical identity between the BCD coded counter outputs and the coded switch outputs. Since the BCD outputs of the thumbwheel switches are opposite in polarity from those of the counters, anti-comparators are used to detect numerical identity rather than direct comparators. Each complete 4-digit (16 bit) anti-comparator circuit produces a (1) output when each of its 16 input


PORTION MODE SWITCH S6
RECEIVER GATE COUNTER CARD NO'S 9 AND 16
4 LINES BCD
DECADE COUNTER 9A1
DECADE COUNTER 9A2
DECADE COUNTER 9A3
DECADE COUNTER 9A4
DECADE COUNTER 9A5
DECADE COUNTER 16A1
DECADE COUNTER 16A2
DECADE COUNTER 16A3
DECADE COUNTER 16A4
RESET
MAIN COUNTERS
RECEIVER "ON" COUNTERS
TYPICAL WAVEFORM
+4V DC
0V DC
ANTI-COMPARATOR A CARD NO'S. 8,10,11,12 AND 15
8A1-8A15
7A1-7A7
10A1-10A15
13A1-13A7
11A1-11A15
13A5-13A11
12A1-12A15
14A1-14A7
15A1-15A15
14A5-14A11
BCD 16 LINES
ANTI-COMPARATOR B CARD NO'S. 7,13 AND 14
LINE SYNC AND EXTERNAL CONTROL CARD NO. 4
60~ FROM 5V POWER SUPPLY
60~ TRIGGER 4A3
REMOTE TIME MULT SELECTION (206A ONLY) 4A1, 4A2
3 LINES
6 LINES
PERIOD TIME SELECTOR S5 4 DIGIT THUMBWHEEL
TRANSMIT GATE TIME SELECTOR S1 4 DIGIT THUMBWHEEL
TRANSIENT DELAY TIME SELECTOR S2 4 DIGIT THUMBWHEEL
RECEIVER DELAY TIME SELECTOR S3 4 DIGIT THUMBWHEEL
RECEIVER ON TIME SELECTOR S4 4 DIGIT THUMBWHEEL
OSCILLATOR AND COUNTERS CARD NO.5
TIME MULT SW S7
X1
X10
X100
XTAL CLOCK 5A9
3 MHZ
DIVIDE BY 3 CIRCUIT 5A1, 5A2
1 MHZ
DIVIDE BY 10 CIRCUIT 5A4
100 KHZ
10 KHZ
1 KHZ
CLOCK PROCESSOR 5A6, 5A7, 5A8
1 μSEC
CLOCK
STROBE
16 LINES (216A ONLY)
J12
PERIOD REMOTE INPUT OR SETTING INDICATOR OUTPUT
16 LINES (206A ONLY)
J13
TRANSMIT GATE REMOTE INPUT OR SETTING INDICATOR OUTPUT
J14
TRANSMIT DELAY REMOTE INPUT OR SETTING INDICATOR OUTPUT
J15
RECEIVER DELAY REMOTE INPUT OR SETTING INDICATOR OUTPUT
J16
RECEIVER ON REMOTE INPUT OR SETTING INDICATOR OUTPUT

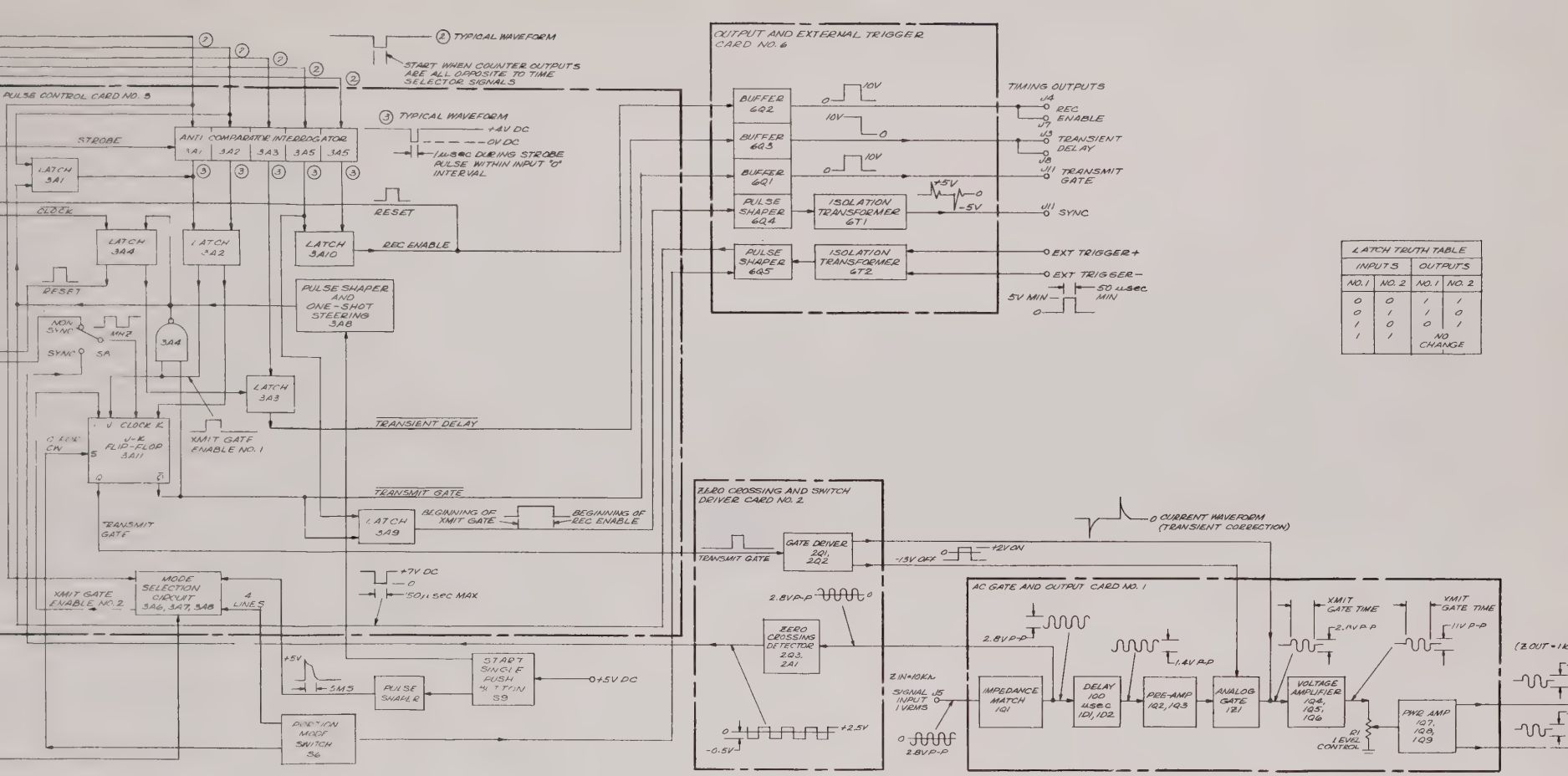


Figure 4-1. Model 206, Functional Block Diagram

LATCH TRUTH TABLE			
INPUTS		OUTPUTS	
NO. 1	NO. 2	NO. 1	NO. 2
0	0	1	1
0	1	1	0
1	0	0	1
1	1	NO CHANGE	

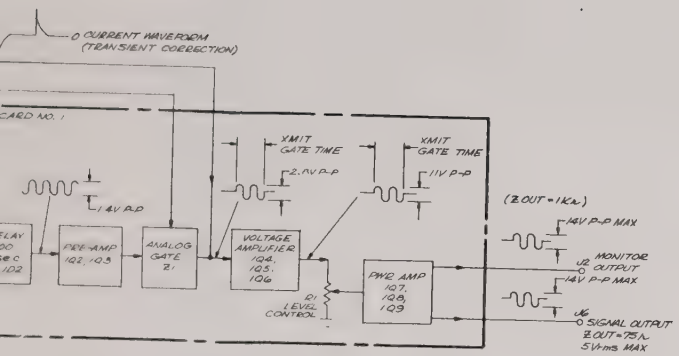


Figure 4-1. Model 206, Functional Block Diagram

pairs simultaneously show opposite polarity inputs. A simplified truth table (positive logic) for a 1-bit anti-comparator would be as follows:

Inputs		Output
A1	S1	
0	0	0
0	1	1
1	0	1
1	1	0

4-11. OUTPUT GATING.

4-12. Outputs from the anti-comparators are applied to the anti-comparator interrogator located on circuit card No. 3. In addition to the anti-comparator outputs, the Strobe and $\overline{\text{Clock}}$ pulses are also applied to circuit card No. 3. The compared inputs together with the Strobe input signal enables NAND gates 3A1 and 3A2. The outputs of these NAND gates are applied to latch 3A2 at the proper time providing inputs to the J-K flip flop. The resultant change in state, if any, of the J-K flip flop will be dependent upon the state it is in at the time of application of these inputs and the input signals via the SYNC/NON-SYNC switch and the mode selection circuits (3A6, 3A7, 3A8). The $\overline{\text{Transmit Gate}}$ pulse from the $\overline{Q}$ output is applied through 6Q1 to J11 and to J1 via latch 3A9, pulse shaper 6Q4 and isolation transformer 6T1. The $\overline{\text{Rec Enable}}$ and $\overline{\text{Transient Delay}}$ pulses are generated in a similar manner except that the J-K flip flop is not used. These pulses are applied to buffer circuits 6Q2 and 6Q3 respectively. Via these circuits, the Rec Enable and Transient Delay pulses are applied to connectors J4 and J7, J3 and J8 respectively. Refer to paragraph 4-17 for the timing relationship of the output waveforms. The Transmit Gate pulse is outputted from the J-K flip flop Q output and applied to gate driver, 2Q1 and 2Q2.

4-13. Synchronization of the Transmit Gate with the zero crossings of the a-c signals is selected by the SYNC/NON-SYNC toggle switch. The sychronization signal is provided by the zero crossing detector (2Q3, 2A1) located on circuit card No. 2. This signal is used as the clock input for the J-K flip flop with the enable signal of latch 3A2 as the combined enable control signal for the J-K flip flop. For non-synchronous gating, the front panel switch selects the 1 mHz signal, provided by divider circuit (5A1, 5A2) located on card No. 5 and substitutes this signal as the clock input on the J-K flip flop in lieu of the zero-crossing signal.

4-14. The five modes of operation are controlled by a five-position rotary switch (S6) and a pushbutton switch (S9). In the CW mode, the Transmit Gate output of the J-K flip flop 3A11

is enabled directly through the set input of the J-K flip flop 3A11. In the INT mode, the internal 3 mHz oscillator is used to time the outputs in gated operation. In the EXT mode, the PERIOD-MS switch is inoperative. An external signal is applied to isolation transformer 6T2 via external trigger jacks to initiate each cycle. The output of the isolation transformer 6T2 is applied to pulse shaper 6Q5 where the signal is shaped and applied to latch 3A1 to be used to start a cycle which is completed in accordance with the other timing switch settings. In the SINGLE mode, the PERIOD-MS switch is again inoperative. The START SINGLE pushbutton (S9) is used to initiate each cycle. This is accomplished by using the output of a pulse shaper and applying it to mode selection circuit 3A6, 3A7 and 3A8 on circuit card No. 3. This output is used as the enable input to the J-K flip flop 3A11 to provide the one gated cycle. Pushbutton switch S9 is also used to provide a +5 volt to ground input to pulse shaper 3A8. The output of pulse shaper 3A8 is used to set latches 3A1 and 3A4. In the LINE SYNC mode, a 60 Hz input from the 5-volt power supply is applied to 60 ~ trigger 4A3. The output of the 60 ~ trigger 4A3, a positive going 2.5 volt square wave, is differentiated and applied to mode selection circuit 3A6, 3A7, and 3A8 on card No. 3. This output is used as the enable input to the J-K flip flop 3A11.

4-15. One volt rms from impedance matching circuit 1Q1 on circuit card No. 1 is applied to the zero crossing detector 2Q3, 2A1 on circuit card No. 2 and to delay lines 1D1 and 1D2. The signal is delayed 100 microseconds and applied to preamplifiers 1Q1, 1Q3. The delayed signal is amplified and applied to analog gate 1Z1 consisting of two MOS FET's. The output of analog gate 1Z1 together with a transient correction from gate driver 2Q1 and 2Q2 is applied to voltage amplifier 1Q4, 1Q5 and 1Q6. The output of the voltage amplifier is fed to potentiometer R1 which is the AC OUTPUT LEVEL control located on the front panel. The potentiometer output is applied to power amplifier 1Q7, 1Q8 and 1Q9 where it is amplified and routed to external equipment via connector J6 as a maximum signal of 5 volts rms. The signal is also monitored at connector J2. The output impedance is approximately 1 kilohm at the monitor point.

4-16. Power for the circuits is supplied by two power supplies. One power supply provides the +24 vdc and -24 vdc power; the other power supply provides the +5 vdc.

4-17. OUTPUT WAVEFORMS.

4-18. The time relationships between the various output waveforms is shown in figures 4-2 and 4-3. Figure 4-2, which illustrates time relationships in the NON-SYNC mode, will be discussed first since all times are directly related to the settings of the front panel timing controls.

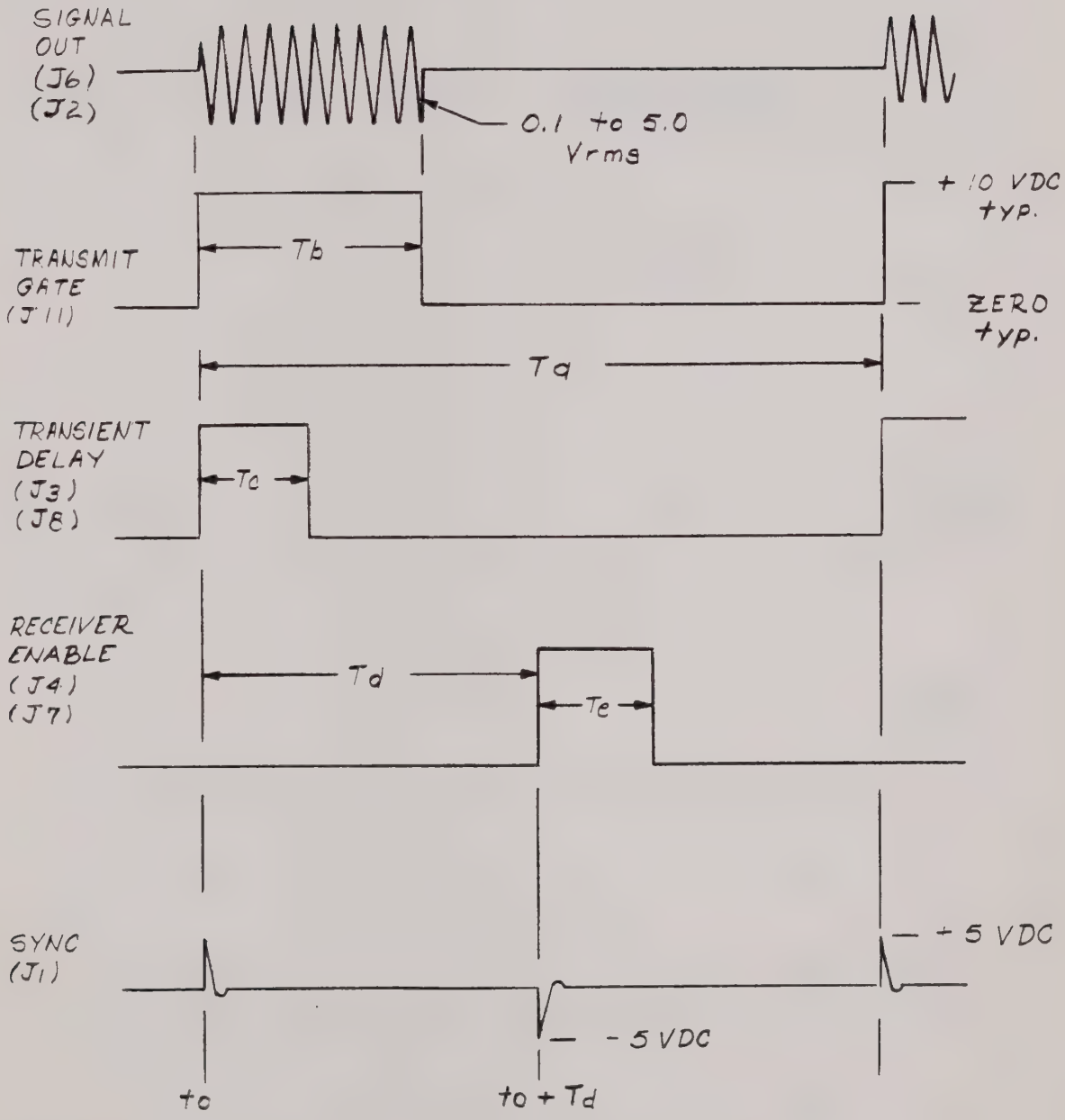


Figure 4-2. Output Waveforms In NON-SYNC Mode

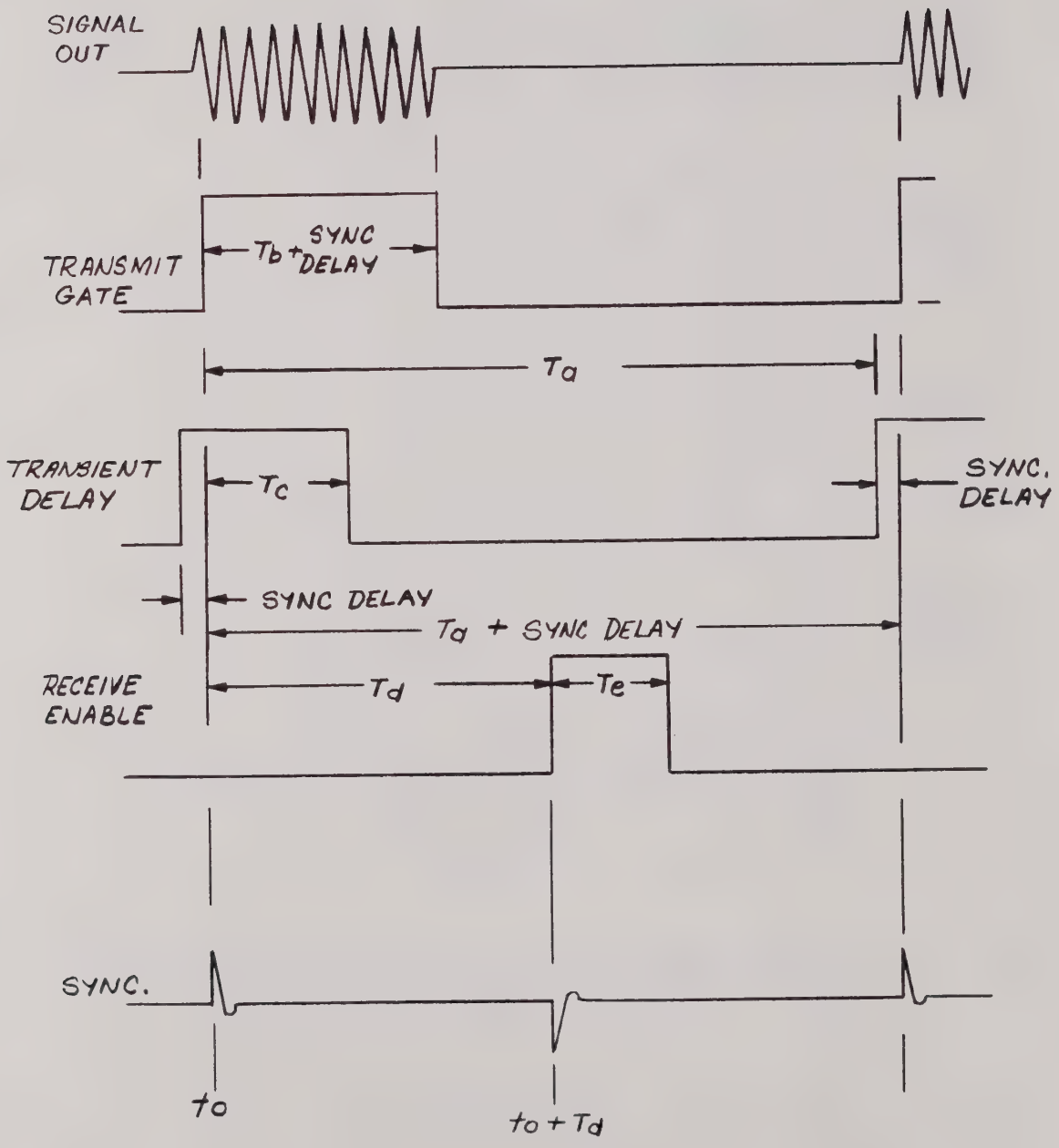


Figure 4-3. Output Waveforms In SYNC Mode

4-19. T_b is the time setting of the TRANSMIT GATE-MS control. It corresponds directly to the positive portion of the Transmit Gate output and to the Signal on time. T_a is the setting of the PERIOD-MS control. It represents one complete cycle of repetitive operation. T_c is determined by the setting of the TRANSIENT DELAY-MS control. T_d is determined by the RECEIVER DELAY-MS control and provides a means of delaying the Receiver Enable pulse. T_e is the period during which the receiver is enabled and its duration is determined by the setting of the RECEIVER ON-MS control. The SYNC output provides a positive pulse which corresponds to the beginning of T_b and a negative pulse which corresponds with the beginning of T_e. These pulses are intended for synchronization of an oscilloscope for observation of waveforms during the "transmit" and "receive" times. Scope sync controls should be able to select the desired polarity. This output is transformer isolated to avoid ground loops through the oscilloscope.

4-20. In the SYNC operating modes, several minor timing changes take place. In figure 4-3, note that the Signal Time and Transmit Gate time both exceed setting of the TRANSMIT GATE-MS control by a period of time described as the "sync delay". This is the time between the end of the TRANSMIT GATE-MS control setting and the next positive going zero crossing of the signal to which turn-off is being synchronized. The period of repetition is similarly lengthened due to the fact that the Transmit Gate may not be turned on until the correct point is reached on the synchronizing waveform. The Receive Enable and Sync outputs are unaffected by synchronized operation.

SECTION V

MAINTENANCE

5-1. GENERAL.

5-2. This section provides instructions to enable personnel to maintain the Model 206. The maintenance concept established for the Model 206 is repair and replacement down to the printed circuit board level. Corrective maintenance procedures should be performed by qualified personnel who are familiar with the Model 206 and have read Sections I through IV of this manual.

5-3. CORRECTIVE MAINTENANCE.

5-4. Corrective maintenance procedures such as troubleshooting, removal and replacement are provided in subsequent paragraphs. These procedures will enable personnel to locate a malfunction and repair the defective component (keeping within the maintenance concept). Schematic diagrams, figures 5-3 through 5-15, are located at the end of this section and will be used to support the corrective maintenance procedures.

5-5. TROUBLESHOOTING.

5-6. Table 5-1 provides the troubleshooting procedures necessary to localize a malfunction down to the circuit card level. The table lists the malfunction indication, probable cause and the remedial action which should be taken in order to render the Model 206 operational again. The troubleshooting procedures are supported by the overall block diagram (figure 4-1), interconnection diagram (figure 5-3), the circuit card schematic diagrams (figures 5-4 through 5-15), and the power supply schematic diagrams (figures 5-16 and 5-17). Prior to performing the troubleshooting procedures prepare the Model 206 as follows:

a. Set the PERIOD-MS switch to 1 ms.

b. Set all other switches to 100 us.

c. Set the GATE SYNC/NON SYNC switch to NON SYNC.

d. Set the MODE switch to INT.

e. Set the TIME MULT switch to 1.

f. Provide a 1 volt rms undistorted 10 kHz sine wave input to INPUT connector J5.

Table 5-1. Troubleshooting Procedures

Step	Malfunction Indication	Probable Cause	Remedy
1	With POWER switch S10 in the on (up) position, blower BL1 does not operate and POWER lamp I1 does not light.	1. Fuse MDL 1/2A F1 defective. 2. Switch S10 defective.	1. Check fuse. Replace if defective. 2. Check switch S10. Replace if defective.
2	With POWER switch S10 in the on (up) position, blower BL1 does not operate but POWER lamp I1 lights.	Blower BL1 defective.	Check blower BL1. Replace if defective.
3	With POWER switch S10 in the on (up) position, blower BL1 operates but POWER lamp I1 does not light. There is also an absence of +5 volt power.	1. POWER lamp I1 defective. 2. Dual power supply defective. 3. +5 volt power supply defective.	1. Check lamp I1. Replace if defective. 2. Check output of dual power supply. Replace if defective. 3. Check output of +5 volt power supply. Replace if defective.
4	No outputs at connectors J1, J3, J4 and J11.	1. Input power of +5 volts and/or ±24 volts not present at each card. 2. A 3 mHz logic output not present at Card No. 5, pin 7.	1. Check input power of +5 volts and/or ±24 volts at each card. Check output of both power supplies. If not present, replace defective power supply. 2. Check for output. If not present, replace Card No. 5.

Table 5-1. Troubleshooting Procedures (Cont)

Step	Malfunction Indication	Probable Cause	Remedy
4 (cont)		3. A 1 KHz logic output not present at Card No. 5, pin H.	3. Check for output. If not present, replace Card No. 5.
		4. A 10 KHz logic output not present at Card No. 5, pin 6.	4. Check for output. If not present, replace Card No. 5.
		5. A 100 KHz logic output not present at Card No. 5, pin E.	5. Check for output. If not present, replace Card No. 5.
		6. A 100 KHz logic input not present at Card No. 4, pin B due to defective switch S7 and/or wiring.	6. Check for input at Card No. 4. If not present, check switch and/or wire. Replace if defective.
		7. A 100 KHz logic output not present at Card No. 4, pin A.	7. Check for output. If not present, replace Card No. 4.
		8. A 100 KHz logic input not present at Card No. 5, pin J due to defective wire.	8. Check for input. If not present, replace defective wire.
		9. A negative going logic output ($\overline{\text{Clock}}$) of 1 us every 10 us is not present at Card No. 5, pin 13.	9. Check for output. If not present, replace Card No. 5.

Table 5-1. Troubleshooting Procedures (Cont)

Step	Malfunction Indication	Probable Cause	Remedy
4 (cont)		10. A positive going logic output (Clock) of 1 us every 10 us is not present at Card No. 5, pin 14.	10. Check for output. If not present, replace Card No. 5.
		11. A 1 us pulse every 10 us is not present at Card No. 5, pin K.	11. Check for output. If not present, replace Card No. 5.
		12. A positive going logic output (Clock) of 1 us every 10 us is not present at Card No. 9, pin H due to defective wiring.	12. Check for input. If not present, replace defective wire.
		NOTE Remove Card No. 3 and ground pin A of Cards No. 9 and 16 before performing the following checks.	
		13. A logic output once each second is not present at Card No. 9, pin 14.	13. Check for output. If not present, replace Card No. 9.

Table 5-1. Troubleshooting Procedures (Cont)

Step	Malfunction Indication	Probable Cause	Remedy
4 (cont)		14. A logic output approximately every 100 ms is not present at Card No. 16, pin 10.	14. Check for output. If not present, replace Card No. 16.
		15. 10 us pulses every second are present at Card No. 7, pin L. 10 us pulses every 100 ms are present at Card No. 13, pins L and 10, and Card No. 14, pins L and 10. NOTE Remove all grounds. Replace Card No. 3.	15. If outputs are obtained, replace defective Card No. 3.

Table 5-1. Troubleshooting Procedures (Cont)

Step	Malfunction Indication	Probable Cause	Remedy
4 (cont)		16. 10 us pulses every 1 ms are not present at Card No. 3 pin E due to defective switch S6 and/or wiring.	16. Check for input. If not present, replace defective switch S6 and/or wire. If input is present remove Card No. 7 and substitute Card No. 13 in its place. If input is present, replace Card No. 7. If input is still not present, remove Card No. 8 and substitute Card No. 10 in its place. If input is present, replace Card No. 8.
5	No output at SYNC OUT connector J1.	1. RECEIVER DELAY-MS switch setting is less than 30 us. 2. Wiring to connector J1 defective.	1. Reset switch setting to 30 us or more. 2. Perform continuity check between connector and pins N and S on Card No. 6. If defective replace wire and/or connector J1.

Table 5-1. Troubleshooting Procedures (Cont)

Step	Malfunction Indication	Probable Cause	Remedy
5 (cont)		3. A square wave input with a turn on at the beginning of the PERIOD-MS switch setting and a turn off at the RECEIVER DELAY-MS switch setting is not present at Card No. 6, pin K.	3. Check for input. If input is present replace Card No. 6. If input is not present, check wire between pin K of Card No. 6 and pin R of Card No. 3. Replace wire if defective.
		4. Square wave in item 3 is not present at Card No. 3, pin R.	4. Check for output. If not present, replace Card No. 3.
6	No output at TRANSIENT DELAY connectors J3 and J8.	1. Wiring to connectors J3 and J8 defective.	1. Perform continuity check between connectors and pin A on Card No. 6. If defective, replace wire and/or connector(s), J3, J8.
		2. A square wave input ending at the PERIOD-MS switch setting and beginning at the TRANSIENT DELAY-MS switch setting is not present at Card No. 6, pin J.	2. Check for input. If input is present, replace Card No. 6. If input is not present, check wire between pin J on Card No. 6 and pin 5 on Card No. 3. Replace wire if defective.
		3. Square wave in item 2 is not present at Card No. 3, pin 5.	3. Check for output. If not present, replace Card No. 3.

Table 5-1. Troubleshooting Procedures (Cont)

Step	Malfunction Indication	Probable Cause	Remedy
6 (cont)		4. A negative going input pulse at TRANSIENT DELAY-MS switch setting is not present at Card No. 3, pin 1.	4. Remove Card No. 13 and substitute Card No. 14 in its place. If pulse is present, replace Card No. 13. If pulse is still not present, remove Card No. 11 and substitute Card No. 10 in its place. If pulse is present, replace Card No. 11.
7	No output at RECEIVER ENABLE connectors J4 and J7.	1. Wiring to connectors J4 and J7 defective.	1. Perform continuity check between connectors and pin B on Card No. 6. If wire is defective, replace wire and/or connector(s), J4, J7.
		2. A negative going square wave at RECEIVER DELAY-MS switch setting and goes positive at RECEIVER ON-MS switch setting is not present at Card No. 6, pin H.	2. Check for input. If present, replace Card No. 6. If input is not present, check output at Card No. 3, pin 14. If present, replace defective wire.

Table 5-1. Troubleshooting Procedures (Cont)

Step	Malfunction Indication	Probable Cause	Remedy
7 (cont)		3. A negative pulse corresponding to the RECEIVER DELAY-MS switch setting is not present at Card No. 3, pin S.	3. Check for input. If present, replace Card No. 3. If pulse is not present, check at pin L of Card No. 14. If present, replace wire. If pulse is not present at pin L, remove Card No. 14 and substitute Card No. 13 in its place. If pulse is obtained at pin L, replace Card No. 14. If pulse still does not appear at pin L, remove Card No. 11 and substitute Card No. 12 in its place. If pulse is present at pin L, replace Card No. 12.
		4. A negative pulse corresponding to RECEIVER ON-MS switch setting is not present at Card No. 3, pin 15.	4. Check for input. If present, replace Card No. 3. If pulse is not present, check at pin 10 of Card No. 14. If present, replace defective wire. If pulse is not present at pin 10, remove Card No. 14 and substitute Card No. 13 in its place. If pulse is

Table 5-1. Troubleshooting Procedures (Cont)

Step	Malfunction Indication	Probable Cause	Remedy
7 (cont)			obtained at pin 10, replace Card No. 14. If pulse still does not appear at pin 10, remove Card No. 15 and substitute Card No. 11 in its place. If pulse is present at pin 10, replace Card No. 15.
8	No output at XMIT GATE connector J11.	1. Wiring to connector J11 defective.	1. Perform continuity check between connector and pin C on Card No. 6. If defective, replace wire and/or connector, J11.
		2. A square wave input ending at the PERIOD-MS switch setting and beginning at the TRANSMIT GATE-MS switch setting is not present at Card No. 6, pin C.	2. Check for input. If input is present, replace Card No. 6. If input is not present, check wire between pin J on Card No. 6 and pin 5 on Card No. 3. Replace wire if defective.
		3. Square wave in item 2 is not present at Card No. 3, pin 5.	3. Check for output. If not present, replace Card No. 3.

Table 5-1. Troubleshooting Procedures (Cont)

Step	Malfunction Indication	Probable Cause	Remedy
8 (cont)		4. A negative pulse corresponding to the TRANSMIT GATE-MS switch setting is not present at Card No. 3, pin C.	4. Remove Card No. 13 and substitute Card No. 14 in its place. If pulse is present, replace Card No. 13. If pulse is still not present remove Card No. 10 and substitute Card No. 11 in its place. If pulse is present, replace Card No. 10.
9	No output at AC OUTPUT MONITOR connector J2.	1. Connectors J1 through J8 on Card No. 1 improperly connected.	1. Reconnect each connector making sure that jack is secure.
		2. Wiring to connector J7 is defective.	2. Perform continuity check between connector J2 and J7 on Card No. 1. Replace defective wire and/or connector(s) J2, J7.
		3. A 1 volt rms undistorted 10 KHz sine wave is not present at input connector J4 on Card No. 1.	3. Check for input. If present, perform continuity check between connector J5 and J4 on Card No. 1. Replace wire if defective.

Table 5-1. Troubleshooting Procedures (Cont)

Step	Malfunction Indication	Probable Cause	Remedy
9 (cont)		4. A square wave, positive going from a -11 to +2 volts starting at the beginning of the PERIOD-MS switch setting and ends at the TRANSMIT GATE-MS switch setting is not present at connector J3 on Card No. 1.	4. Check for input. If present, replace Card No. 1. If not present, perform a continuity check between connector J3 on Card No. 1 and J3 on Card No. 2; if wire is defective replace wire. If output still does not appear at connector J3, Card No. 2, check for an input square wave between 4 and 8 volts corresponding to the same time as given in item 4 at pin P of Card No. 2. If present, replace Card No. 2. If input is not present, check for square wave at pin J, Card No. 3. If at pin J the output is present, replace defective wire between pins J and P on Card Nos. 3 and 2, respectively. If the output is not present at pin J, replace Card No. 3.

Table 5-1. Troubleshooting Procedures (Cont)

Step	Malfunction Indication	Probable Cause	Remedy
10	Clipped or distorted output at AC OUTPUT MONITOR connector J2.	Input amplitude at INPUT connector J5 exceeded 1 volt rms.	Check input. If amplitude is correct, replace Card No. 1.
11	No output at AC OUTPUT MONITOR connector J2 with GATE SYNC/NON-SYNC switch S8 in SYNC position.	1. Defective switch S8. 2. Defective wire between switch S8 and Card No. 2, pin S. 3. Defective Card No. 2.	1. Check switch S8. Replace if defective. 2. Perform continuity check. Replace wire if defective. 3. Replace Card No. 2.
12	Operates in INT but not EXT mode. NOTE An external trigger must be provided. See table 1-1 and paragraph 3-8.	1. A square wave of +5 volts, 50 us minimum is not present at pin P of Card No. 6. 2. A negative going 7 volt, approximate 150 us pulse is not present at pin 1 of Card No. 6. 3. Check pin B of Card No. 3 for an output pulse as stated in item 2.	1. Check for input. If not present, perform continuity check between connectors and pins P, 11, and R of Card No. 6. Replace wire if defective. 2. Replace defective Card No. 6. 3. Perform a continuity check between pins 1 and B of Card Nos. 6 and 3 respectively. Replace wire if defective. If pulse is present, replace Card No. 3.

Table 5-1. Troubleshooting Procedures (Cont)

Step	Malfunction Indication	Probable Cause	Remedy
13	No output during single shot operation.	A 5 volt, 5 ms pulse is not present at pin 8 of Card No. 3 when START SINGLE push-button is depressed.	Check for input. If present, replace Card No. 3. If input is not present, check switch S9 and associated circuit. Replace defective component(s).

5-7. REMOVAL.

5-8. This paragraph provides the procedures necessary to remove those parts found to be defective during the troubleshooting procedures. A parts location diagram (figure 5-1) is provided showing the physical location of front and rear panel mounted components as well as circuit card location. To remove a defective component, proceed as follows:

WARNING

De-energize Model 206 before attempting to remove a component.

a. Disconnect all cables to the unit.

b. If rack mounted, remove two screws securing the case assembly to the chassis assembly. This hardware is located at the rear of Model 206.

c. Carefully slide the chassis assembly from the case assembly.

d. For a panel mounted switch, connector or control found defective, unsolder and tag leads.

e. Remove hardware securing switch, connector or control to the panel.

NOTE

Most switches and controls are supplied with mounting hardware however, retain hardware removed for possible use with replacement component.

f. Locate defective circuit card using figure 5-1 and remove the card retainers.

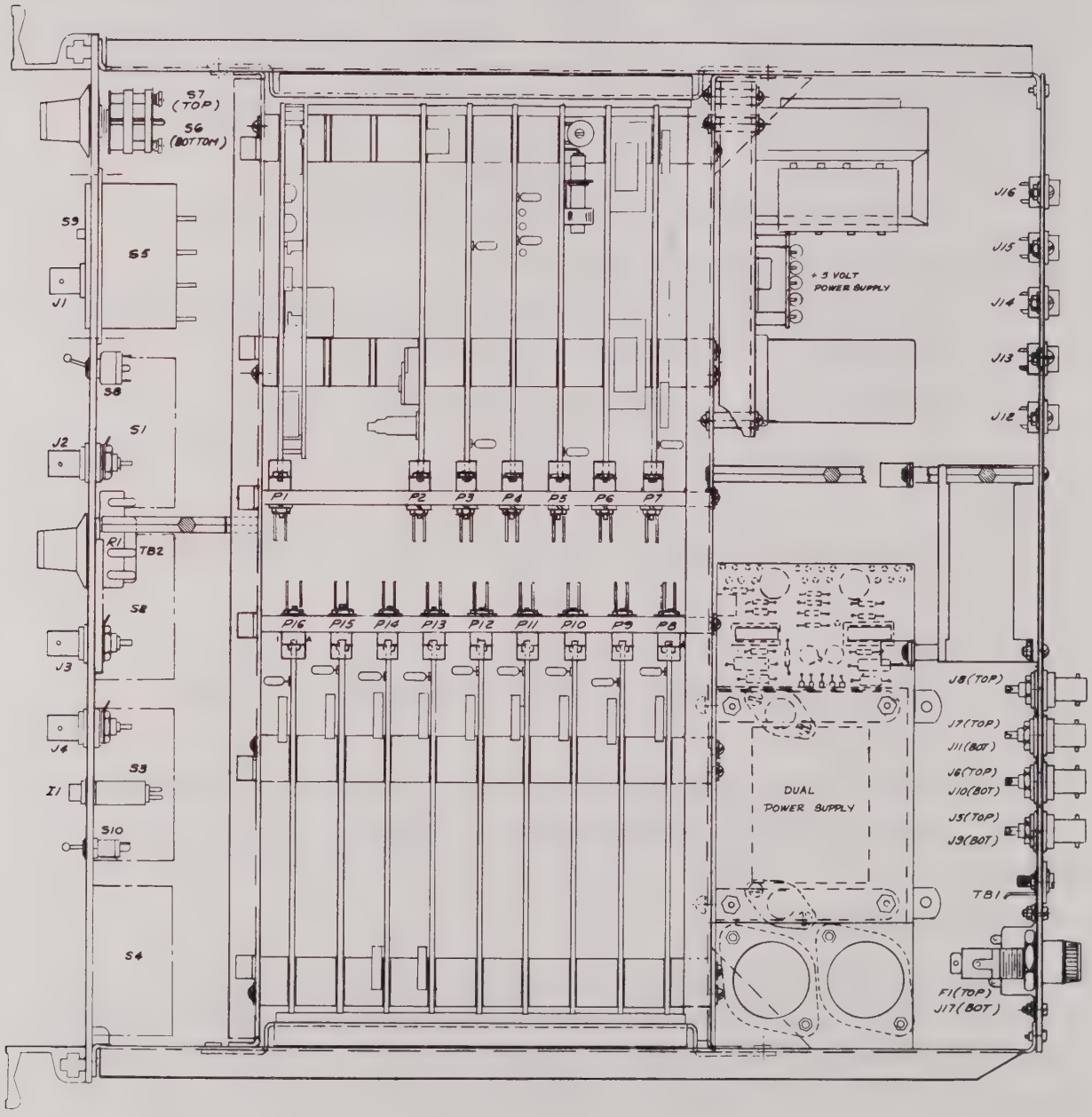
g. Remove circuit card by disconnecting the board from the chassis mounted connector.

5-9. REPLACEMENT.

5-10. The replacement procedures are essentially the reverse of removal. However, a minimum performance check (paragraph 5-13) should be performed after final assembly of Model 206. When reconnecting or replacing electrical parts, observe good maintenance practice. Pay particular attention to the following points:

a. Use exact equivalent component parts, as described in the parts list in Section VI.

b. Place parts and wiring in same locations as before removal.



NOTE: Reference designations located at each connector physically locate the applicable circuit card. For example, circuit card number 3 will plug into connector P3.

Figure 5-1. Model 206, Parts Location Diagram

c. Be careful to avoid damage, particularly by burning insulation, scratching or breaking printed wiring, or pinching wiring.

CAUTION

Be careful not to scratch the printed circuit wiring when replacing the card or if it is necessary to brush or rub the card to remove foreign material.

d. Carefully replace circuit board so as not to damage connector. Card guides facilitate circuit board connection.

5-11. TEST EQUIPMENT.

5-12. The following test equipment is required to perform the minimum performance check:

a. Sinewave signal source, 50 Hz to 3 MHz, 1 volt rms into 10 K Ω in parallel with 100 pf Krohn-Hite Model 4200 recommended.

b. A.C. Voltmeter, 50 Hz to 3 MHz, 100 mv to 10 volts rms, ±1% accuracy, Ballantine Model 303-01 or equal.

c. Electronic Counter, 50 Hz to 3 MHz, 10 volts p-p square wave, ±.001% accuracy, Hewlett-Packard Model 5216A or equal.

d. Dual Channel Oscilloscope, D.C. to 10 MHz, External trigger capability, Tektronix Model 422 or equal.

e. Terminating Resistor, 75 Ω ±5%, 1/4 watt, carbon composition, Allen-Bradley type CB or equal.

5-13. MINIMUM PERFORMANCE CHECK.

5-14. The minimum performance procedures enables the operator to determine whether the circuitry is performing properly. This check can be performed either after installation or when a malfunction has been remedied. To perform this check, connect Model 206 as shown in figure 5-2 using the test equipment described in paragraph 5-11 and proceed as follows:

a. Set the following controls on Model 206 to the position indicated and energize the equipments.

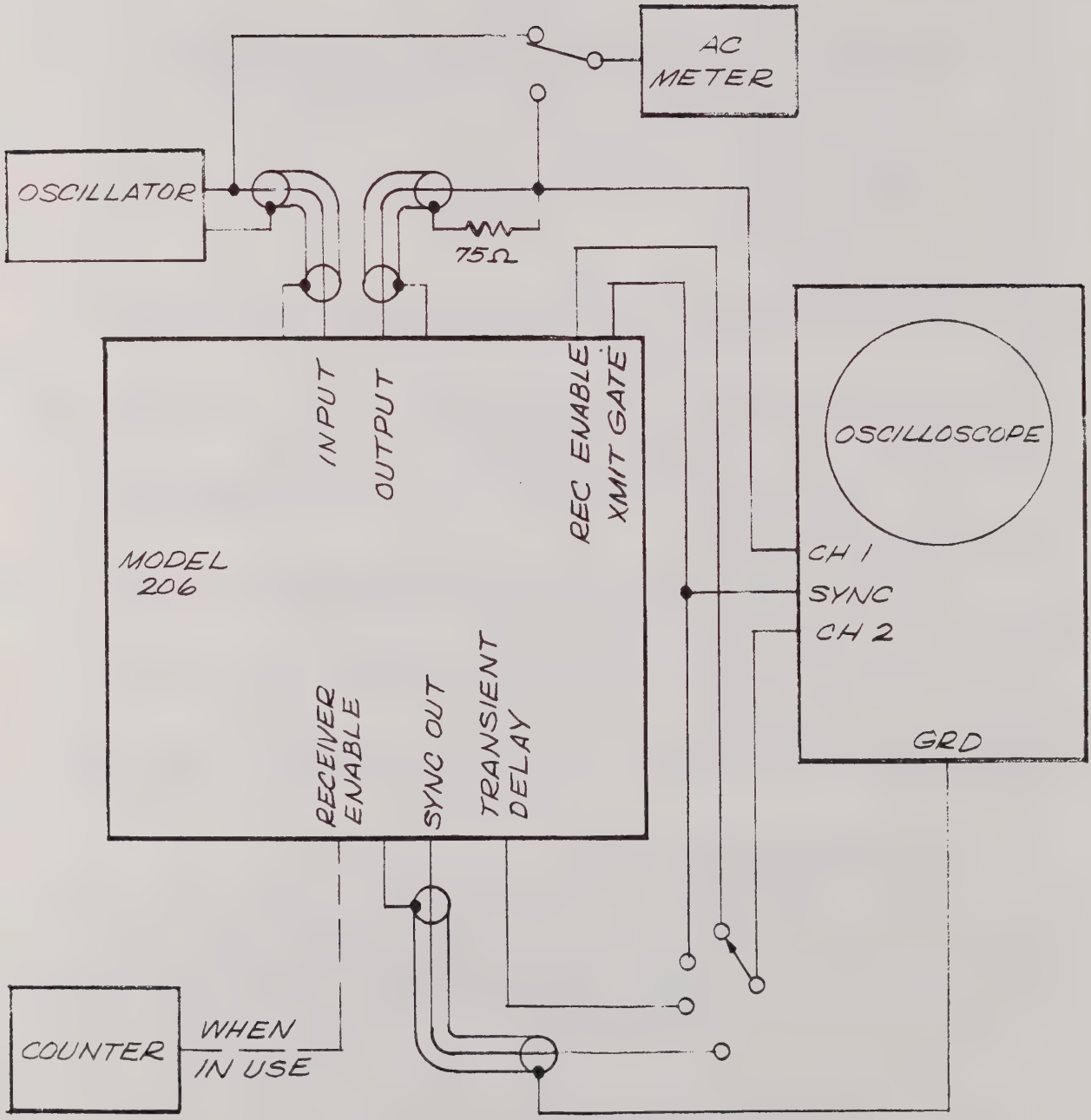


Figure 5-2. Minimum Performance Check, Test Setup

Control	Position
GATE SYNC/NON-SYNC	NON-SYNC
MODE	CW
AC OUTPUT LEVEL	Minimum (CCW)
Sync Select (oscilloscope)	Internal
POWER	On (up)

b. Allow sufficient warm-up of approximately 20 minutes.

c. Check the output level by setting signal frequency to 50 Hz.

d. Set the input level to 1 volt rms.

e. Adjust (increase) the AC OUTPUT LEVEL control until its visible distortion is observed on CH. 1 of the oscilloscope or until the control reaches maximum rotation. The output level should be greater than 1 volt rms as indicated on the ac meter.

f. Change the signal frequency to 3 mHz, and reduce the output amplitude.

g. Repeat step e.

h. Reduce the output level to 1 volt rms.

i. Check the timing accuracy by setting the MODE switch to INT and the TIME MULT switch to 1.

j. Set the PERIOD-MS to 1.0 ms, TRANSMIT GATE-MS to 0.1 ms, TRANSIENT DELAY-MS to 0.2 ms, RECEIVER DELAY-MS to 0.3 ms, and the RECEIVER ON-MS to 0.5 ms.

k. Connect the counter to the RECEIVER ENABLE connector and check that counter indicates a frequency between 999.9 and 1000.1 Hz (10 sec count).

l. Set the TIME MULT switch to 10. The counter should indicate between 99.9 and 100.1 Hz.

m. Set the TIME MULT switch to 100. The counter should indicate between 9.9 and 10.1 Hz.

n. Check the timing waveforms by resetting the TIME MULT switch to 1.

o. Set the oscilloscope sweep speed to 0.1 ms/division. Be sure sweep speed has been recently calibrated.

p. Set the oscilloscope sync to Ext., Postive and adjust for correct triggering.

q. Observe the Transmit Gate on CH 2. Adjust the oscilloscope Horizontal Position control to place the positive edge of this waveform at the left edge of the screen (time zero). The negative transition should then occur between 0.8 and 1.2 divisions from zero. The signal amplitude should be between 8 and 12 volts p-p.

r. Observe the Transient Delay signal on CH 2. It should have a positive transition at zero ± 0.2 divisions and a negative transition between 1.8 and 2.2 divisions. The level should be between 8 and 12 volts p-p.

s. Observe the Receiver Enable signal on CH 2. It should have a positive transition between 2.8 and 3.2 divisions. The level should be between 8 and 12 volts p-p. A negative transition should be observed between 7.8 and 8.2 divisions.

t. Observe the sync output on CH 2. There should be a positive spike of at least 5.0 volts at zero ±0.2 divisions and a negative spike of at least 5.0 volts between 2.8 and 3.2 divisions. If these spikes are not visible increase oscilloscope brightness and modify oscilloscope trigger level setting.

u. Check sync by setting the input signal frequency to 7 kHz and the input level to 1 volt rms.

v. Set the GATE SYNC/NON-SYNC switch to SYNC and observe the signal output on CH 1 of the oscilloscope. The output should consist of a single complete cycle of the signal frequency. The signal should both start and stop at zero crossings.

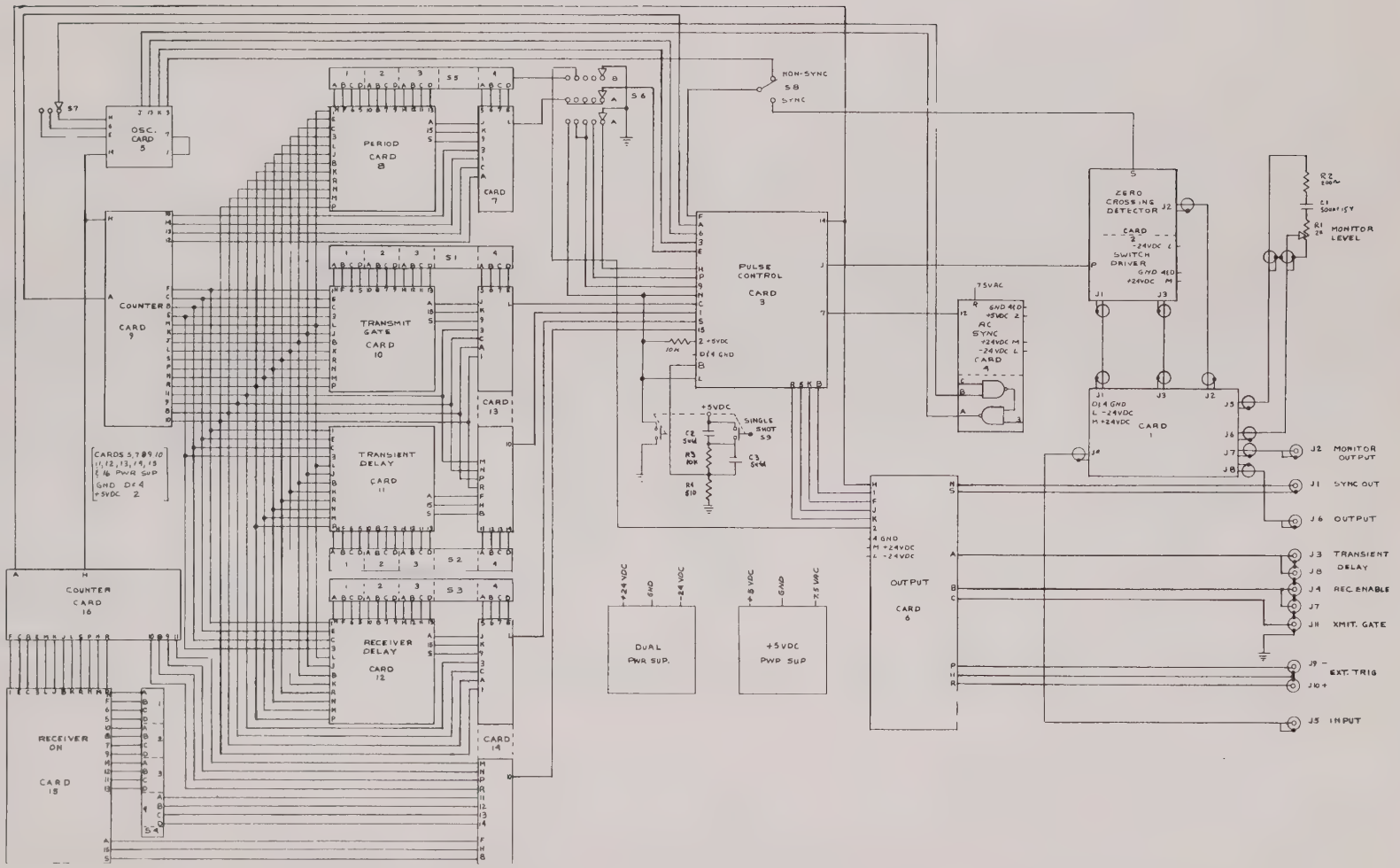


Figure 5-3. Model 206 Interconnection Diagram

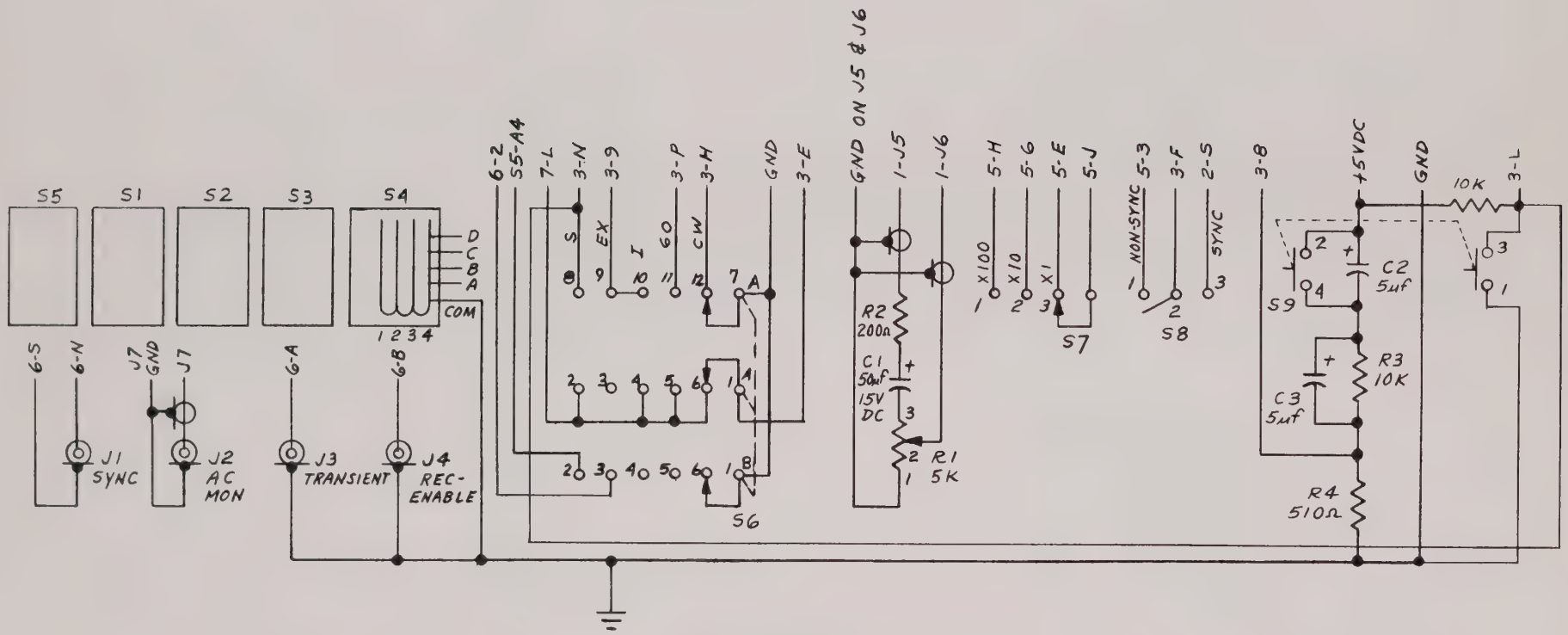


Figure 5-4. Front Panel, Schematic Diagram

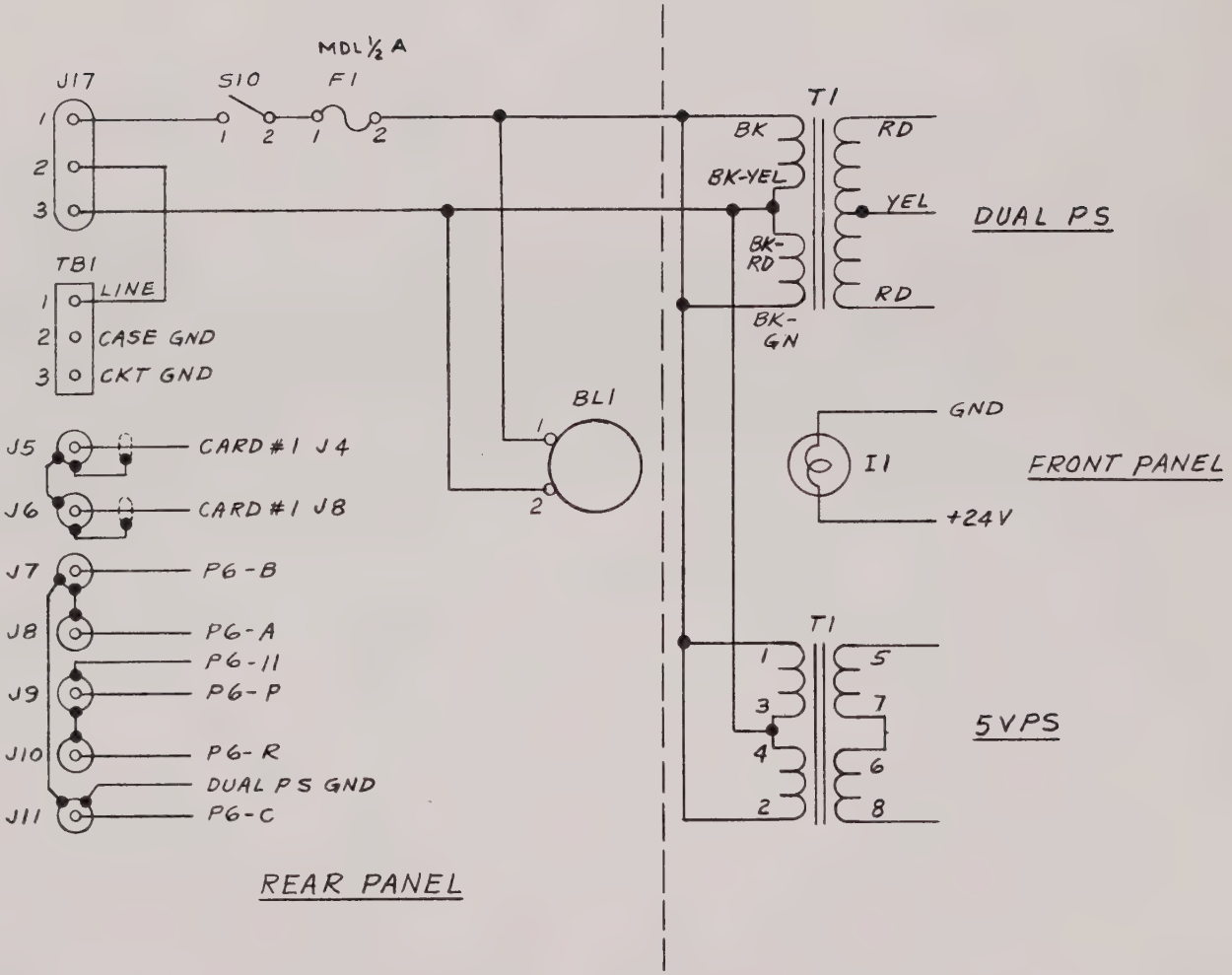


Figure 5-5. Rear Panel and AC Power, Schematic Diagram

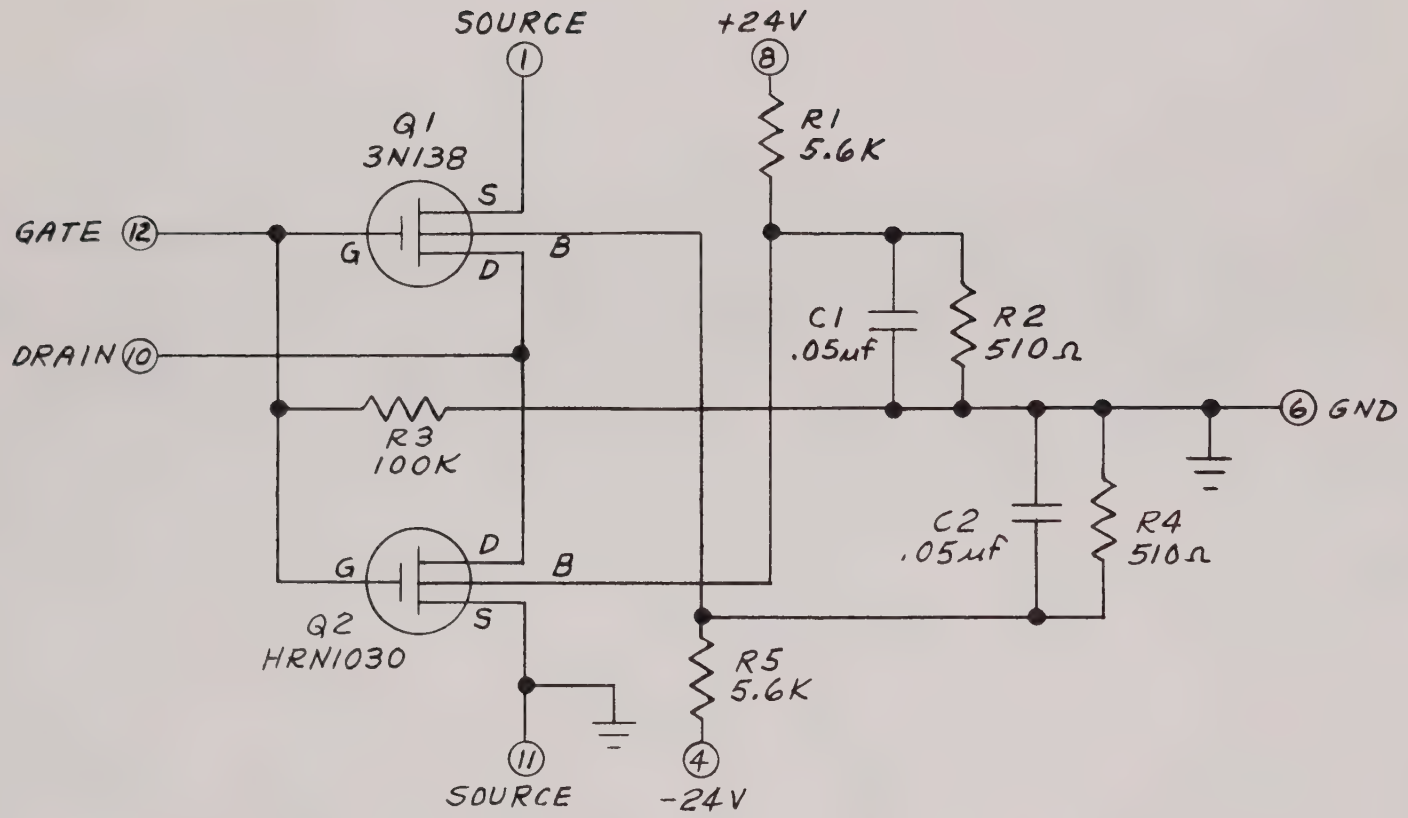


Figure 5-7. Gate Module, Schematic Diagram

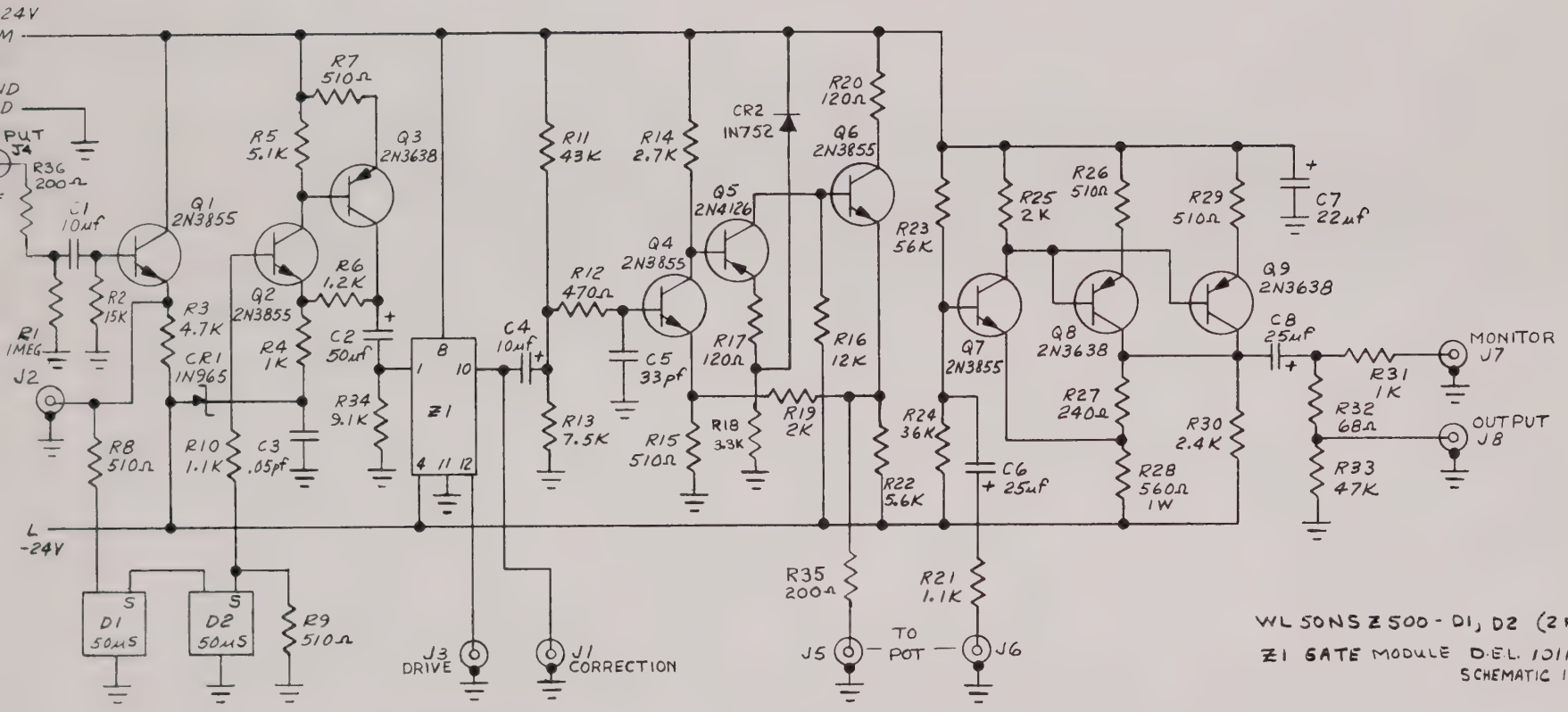


Figure 5-6. AC Gate and Output, Card No. 1, Schematic Diagram

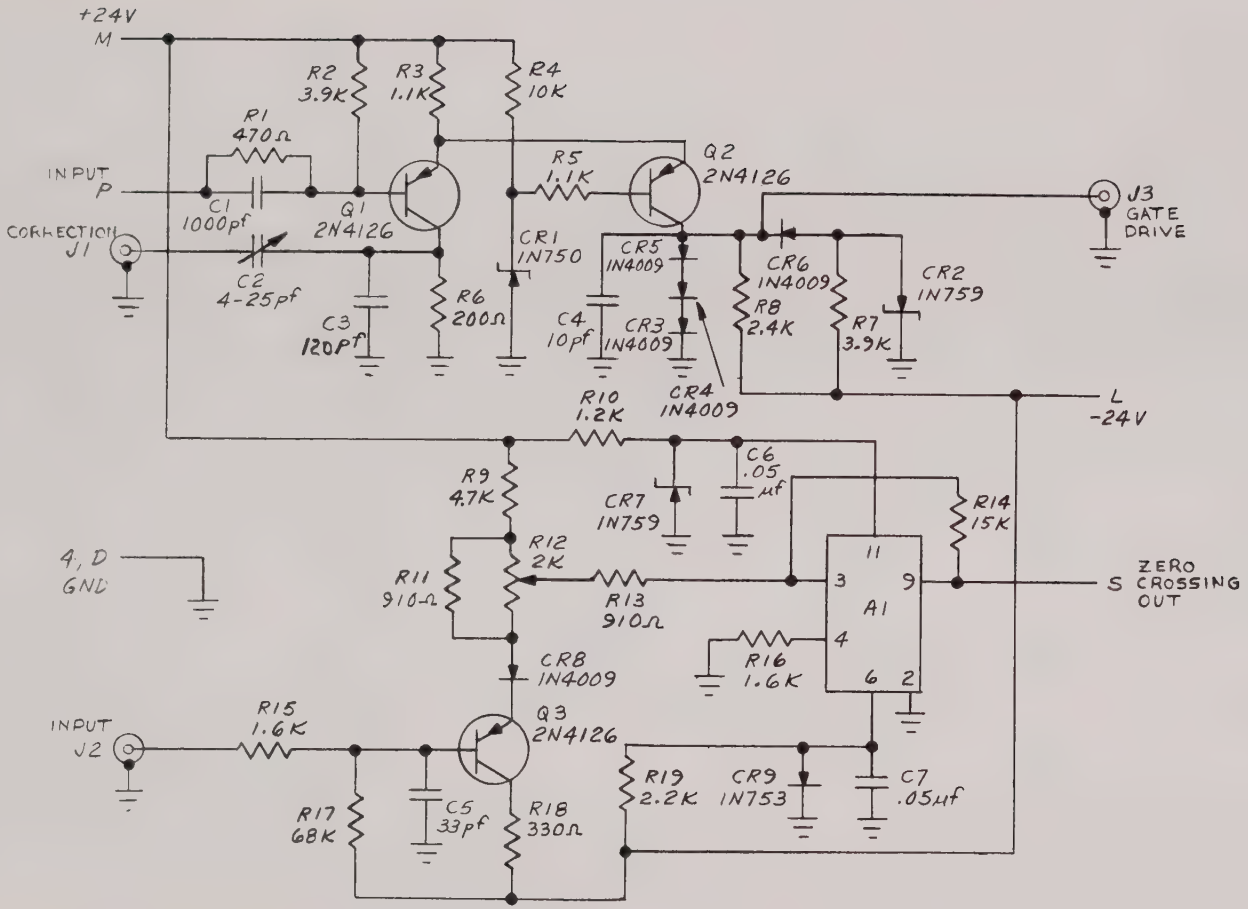


Figure 5-8. Zero Crossing and Switch Driver, Card No. 2, Schematic Diagram

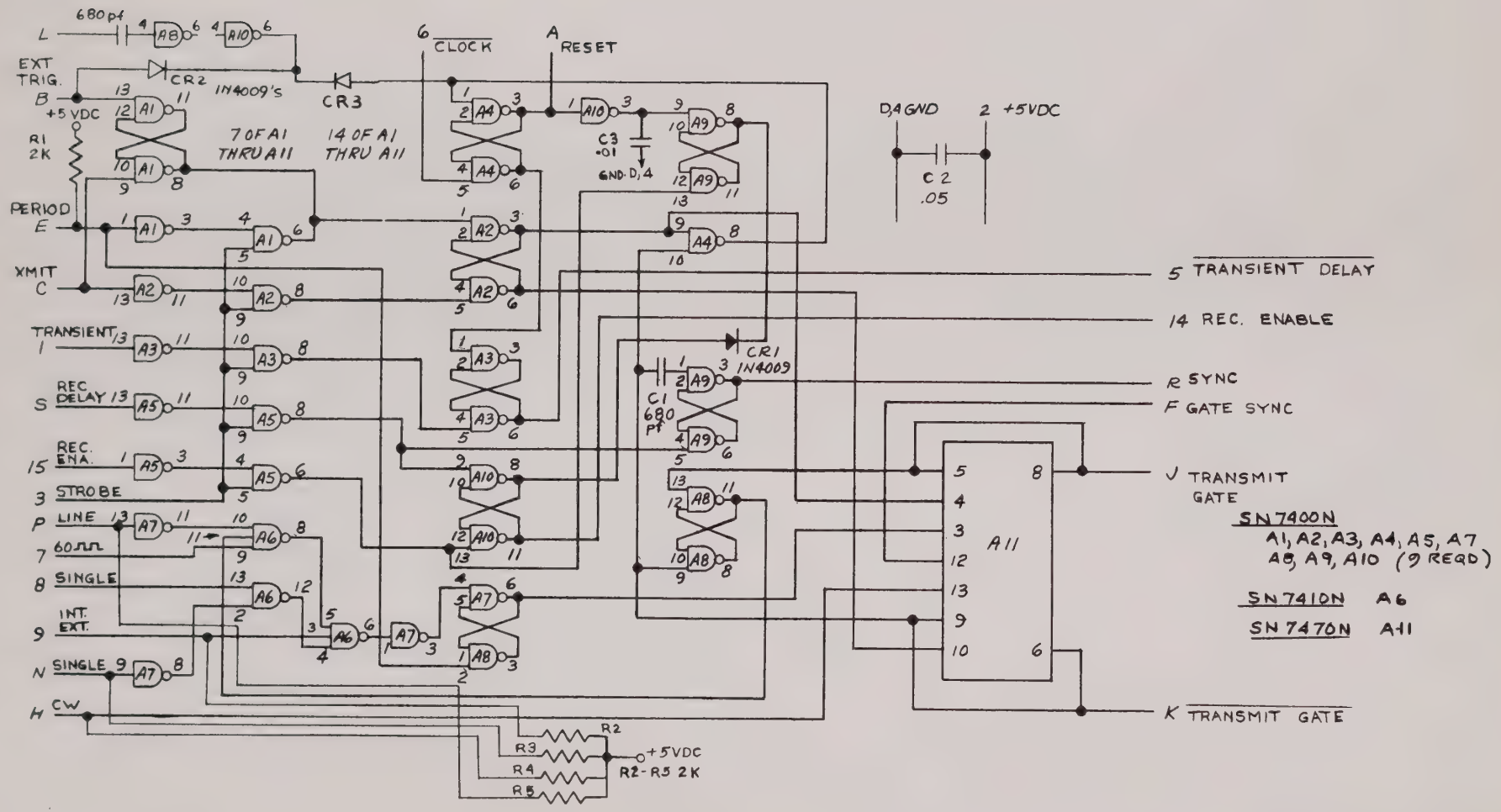


Figure 5-9. Pulse Control, Card No. 3, Schematic Diagram

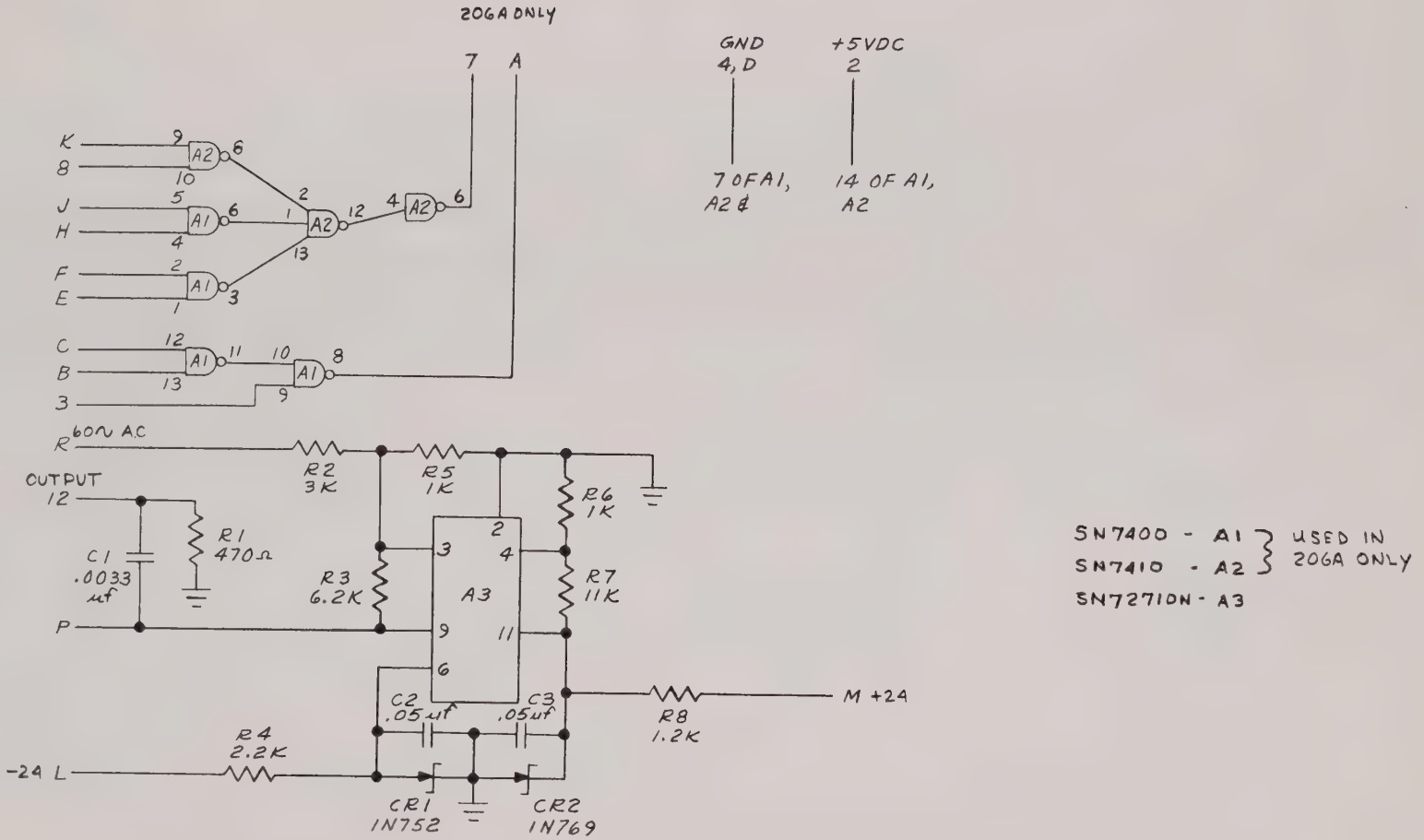
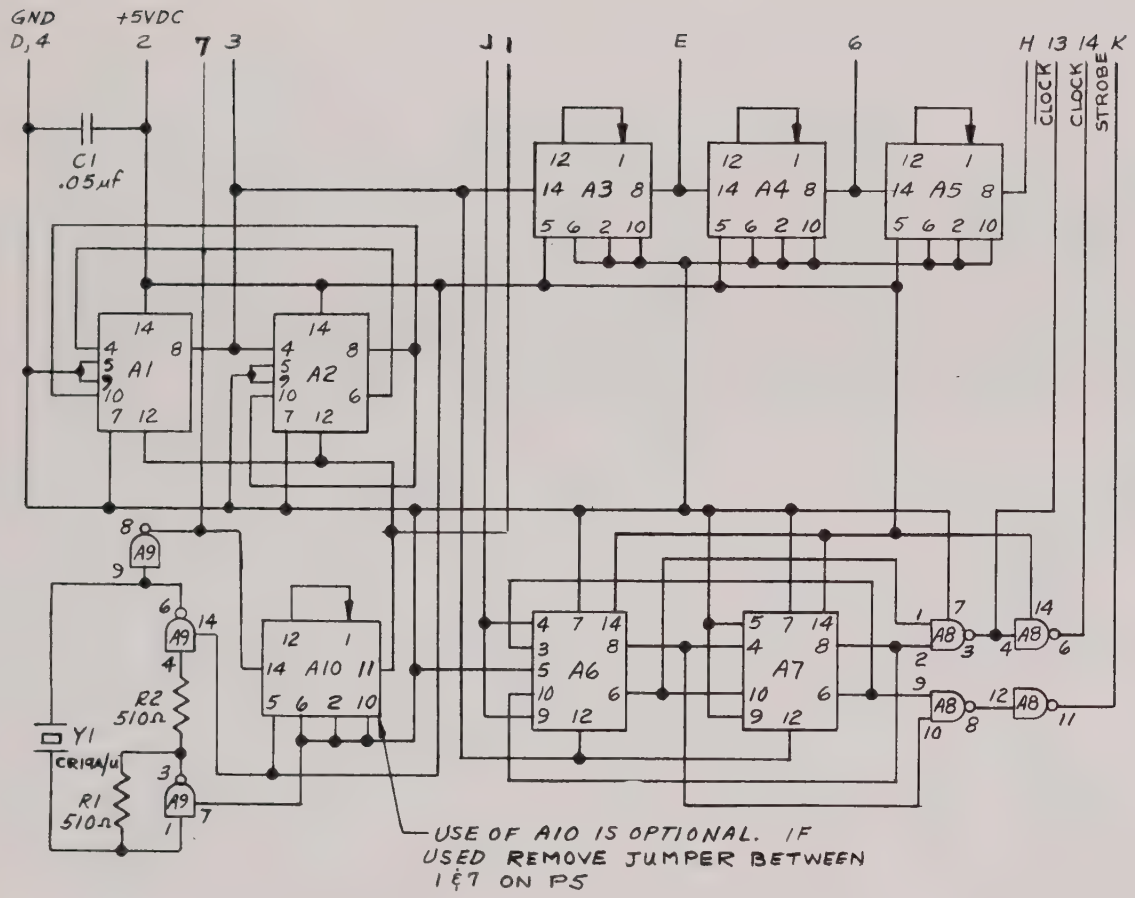


Figure 5-10. Line Sync and External Control, Card No. 4, Schematic Diagram



SN7470N
A1, A2, A6, A7 (4 REQD)

SN7490N
A3, A4, A5, (3 REQD)

SN7400N
A8, A9 (2 REQD)

Figure 5-11. Oscillators and Counters, Card No. 5, Schematic Diagram

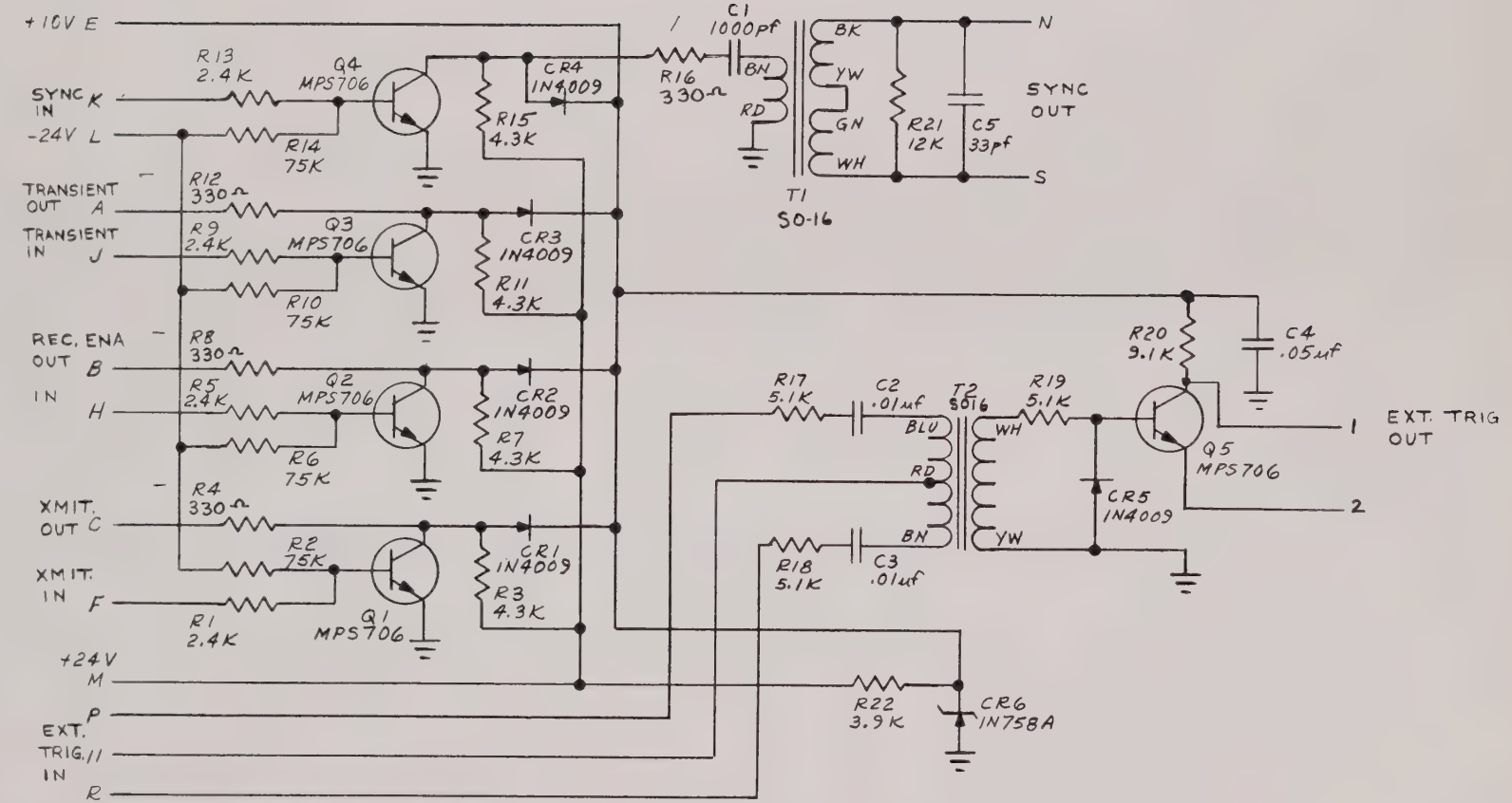


Figure 5-12. Output and External Trigger, Card No. 6, Schematic Diagram

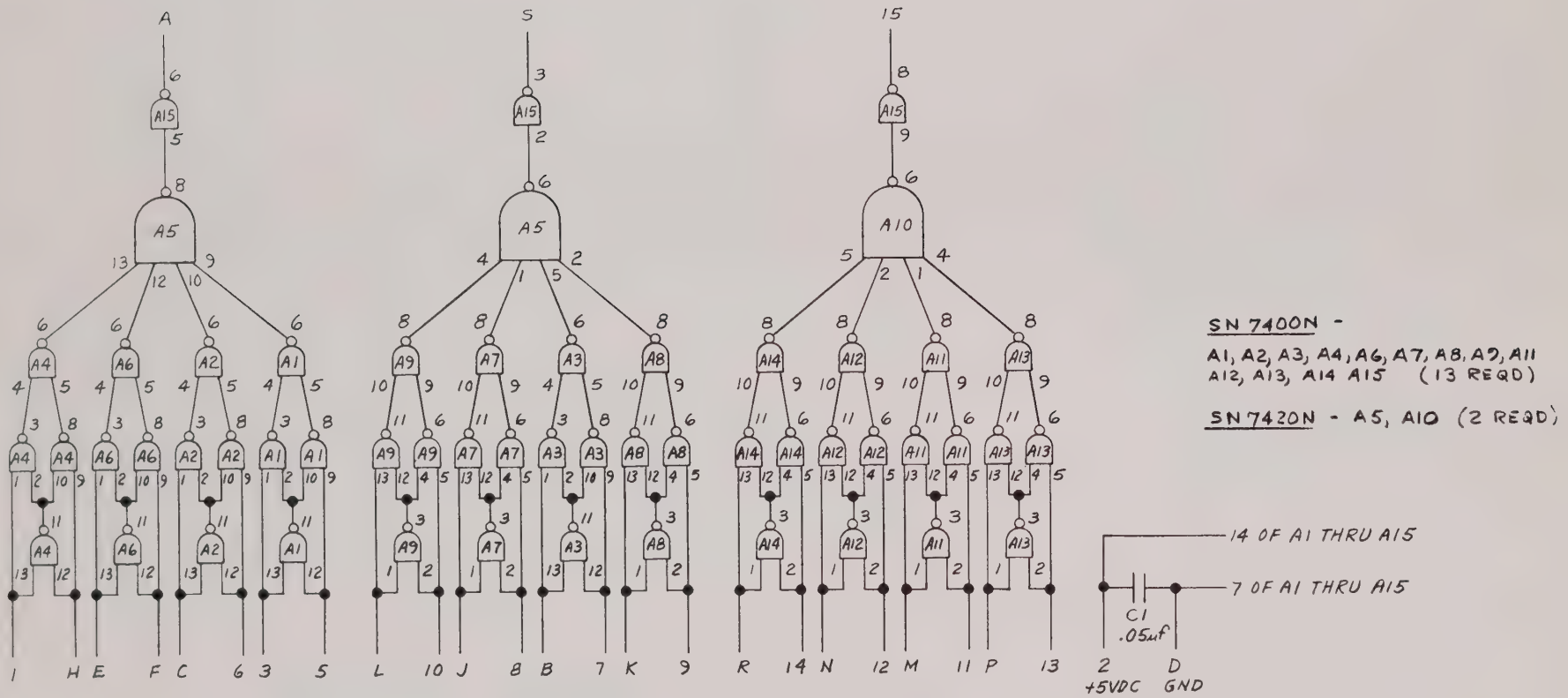
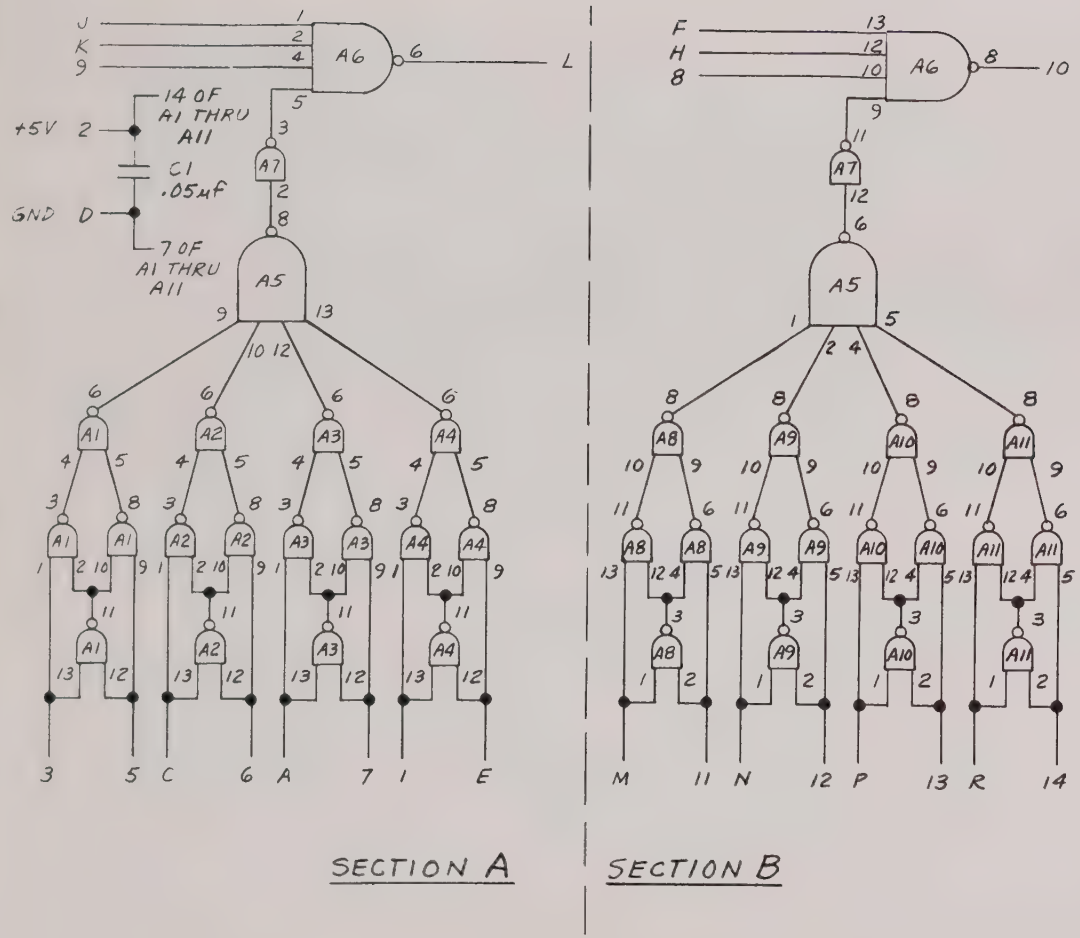


Figure 5-13. Anti-Comparator A, Card No. 8, 10, 11, 12, and 15, Schematic Diagram

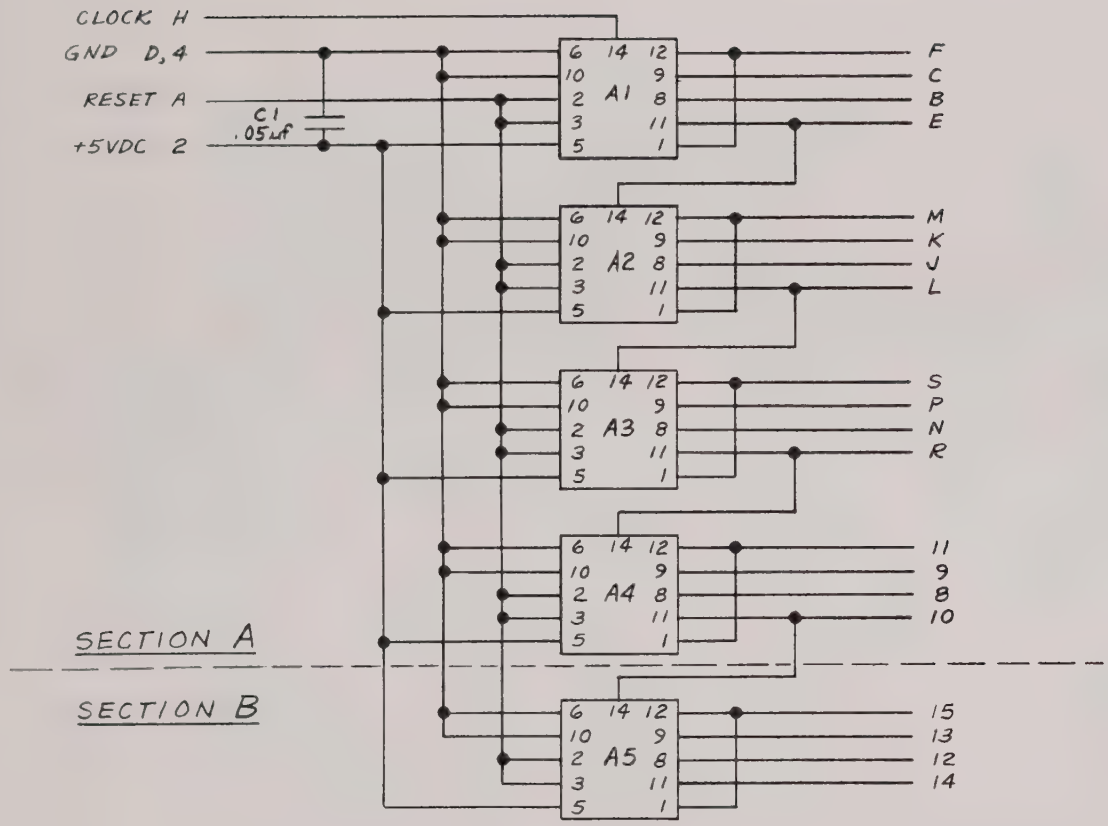


SN7400N
A1, A2, A3, A4, A7, A8
A9, A10, A11, (9 REQD)

SN7420N - A5, A6, (2 REQD)

NOTE: BOARD # 7 CONSISTS OF SECTION A ONLY. BOARD #13 & 14 CONSISTS OF SECTION A & SECTION B.

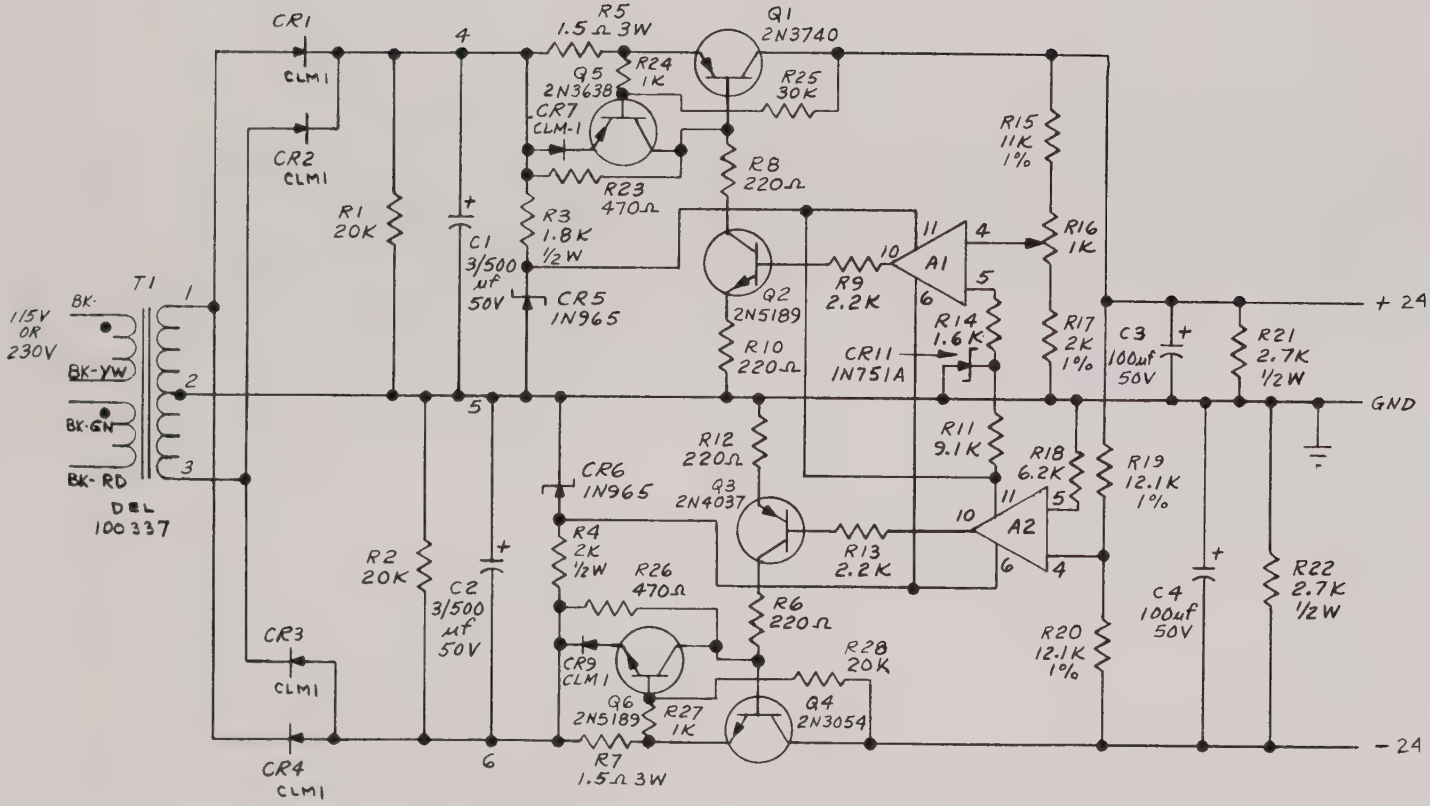
Figure 5-14. Anti-Comparator B, Card No. 7, 13, and 14, Schematic Diagram



A1 THRU A5 - SN7490N

NOTE: BOARD #16 CONSISTS OF SECTION A ONLY. BOARD #9 CONSISTS OF SECTION A & SECTION B.

Figure 5-15. Receiver Gate Counter, Card No. 9 and 16, Schematic Diagram



USE 7741393 - A1, A2 (2 REQD)

Figure 5-16. Dual Power Supply, Schematic Diagram

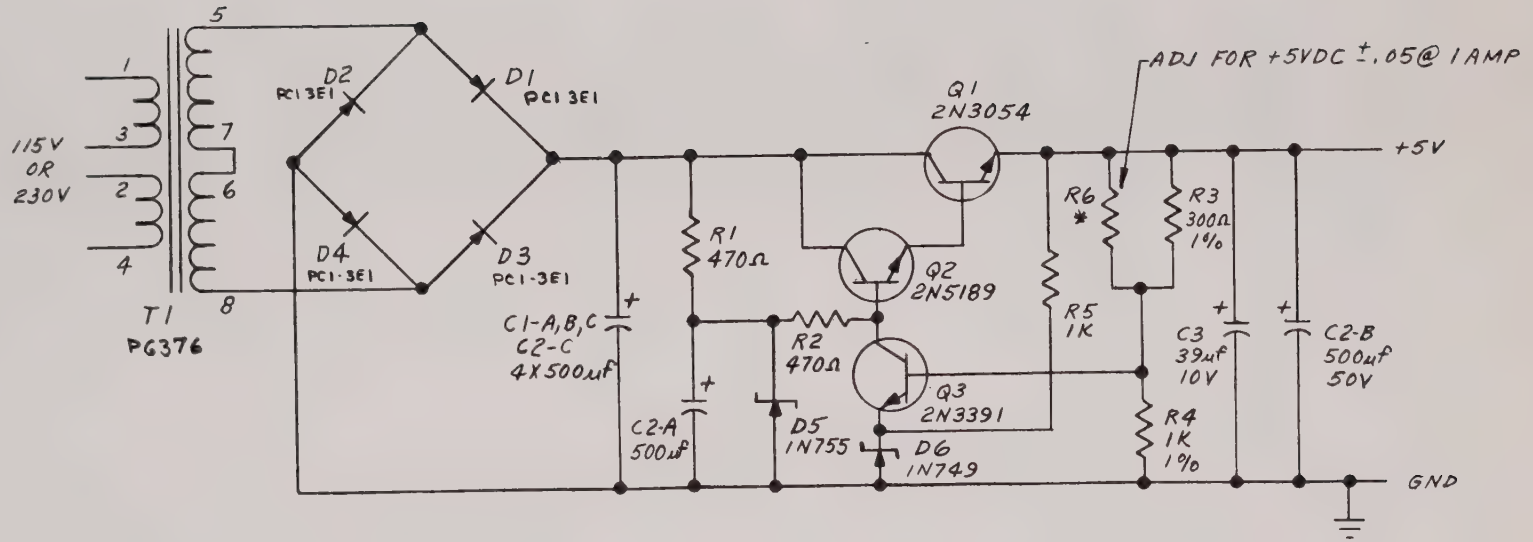


Figure 5-17. +5 Volt Power Supply, Schematic Diagram

SECTION VI

REPLACEMENT PARTS LIST

6-1. GENERAL.

6-2. This section contains the replacement parts list for Models 206 and 206A. The replacement parts used on Model 206A will be noted by an asterisk. This list provides the part number, description, reference designator, and manufacturer of those parts which may be replaced due to malfunction or wear.

6-3. REPLACEMENT PARTS LIST.

6-4. Table 6-1 provides the replacement parts used on Models 206 and 206A including modification for use with external clock.

Table 6-1. Replacement Parts List

Part No.	Description	Ref Des	Mfg
Model 206 Main Assembly			
566	Plug, phone		Keystone
RN60C1102F	Resistor, film 11K, 1%, 1/8w	R15	Ward Leonard
UG-657/u	Connector, BNC	J1 - J4	Amphenol
TE 1160	Capacitor, 50 uf 15 vdc	C1	Sprague
TE 1152	Capacitor, 5 uf 15 vdc	C2, C3	Sprague
DHP 65B	Socket, lite	I1	Eldema
CF03-GCS1762	Lamp	(I1)	Eldema
CMU5021	Potentiometer, 5K 2w	R1	Ohmite
CB2015	Resistor, fixed 200Ω 5% 1/4w	R2	Allen Bradley
CB1035	Resistor, fixed 10K 5% 1/4w	R3	Allen Bradley
CB5115	Resistor, fixed 510Ω 5% 1/4w	R4	Allen Bradley

Table 6-1. Replacement Parts List (Cont)

Part No.	Description	Ref Des	Mfg
Model 206 Main Assembly (Cont)			
PS118032	Index 3 position	S7	Centralab
PS24	Deck 3 pole 2-3 position	S7	Centralab
PS118030	Index 4 position	S6	Centralab
PS22	Deck 2 pole 2-5 position	S6	Centralab
T53	Switch, toggle SPDT sub min	S8, S10	AH & H
30-3	Switch, pushbutton	S9	Grayhill
T20-13MA	Switch, thumb wheel	S1, S2	Cherry Elec Prod Corp
T20-13MA	Switch, thumb wheel	S3, S4	Cherry Elec Prod Corp
T20-12MA	Switch, thumb wheel	S5	Cherry Elec Prod Corp
700ASK7ABS	Knobs		Roger Bros
UG657/u	Connector, BNC	J5, J6, J7, J8, J9, J10, J11	Amphenol
H1061	Connector, AC	J17	Tower
HKP	Holder, fuse	F1	Buss
MDL1/2Amp	Fuse	(F1)	Fusetron
SP2A2	Fan, sprite	BL1	Rotron
DB20962*	Shell, junction		Cannon
DB25P*	Connector		Cannon
DB25S*	Connector	J12, J13, J14, J15, J16	Cannon
Model 206 - Card No. 1			
TE1155	Capacitor, 10 uf 15 vdc	C1, C4	Sprague
TE1160	Capacitor, 50 uf 15 vdc	C2	Sprague

Table 6-1. Replacement Parts List (Cont)

Part No.	Description	Ref Des	Mfg
Model 206 - Card No. 1 (Cont)			
TGS-50	Capacitor, 0.05 uf 50 vdc	C3	Sprague
DM5-330J	Capacitor, 33 pf 300 vdc	C5	Elmenco
TE1207	Capacitor, 25 uf 25 vdc	C6, C8	Sprague
K22C35	Capacitor, 22 uf 35 vdc	C7	Kemet
1N965	Diode, zener	CR1	IRC
1N752	Diode, zener	CR2	IRC
WL50NSZ500	Line, delay	D1, D2	NY/Tronics
572	Jack, phono	J1, J2, J3, J4, J5, J6, J7, J8	Keystone
2N3855	Transistor	Q1, Q2, Q4, Q6, Q7	GE
2N4126	Transistor	Q5	Motorola
2N3638	Transistor	Q3, Q8, Q9	Fairchild
CB1055	Resistor, fixed 1 meg 5% 1/4w	R1	Allen Bradley
CB1535	Resistor, fixed 15K 5% 1/4w	R2	Allen Bradley
CB4725	Resistor, fixed 4.7K 5% 1/4w	R3	Allen Bradley
CB1025	Resistor, fixed 1K 5% 1/4w	R4, R31	Allen Bradley
CB5125	Resistor, fixed 5.1K 5% 1/4w	R5	Allen Bradley
CB1225	Resistor, fixed 1.2K 5% 1/4w	R6	Allen Bradley
CB5115	Resistor, fixed 510Ω 5% 1/4w	R7, R8, R9, R15, R26, R29	Allen Bradley
CB4335	Resistor, fixed 43K 5% 1/4w	R11	Allen Bradley

Table 6-1. Replacement Parts List (Cont)

Part No.	Description	Ref Des	Mfg
Model 206 - Card No. 1 (Cont)			
CB1125	Resistor, fixed 3.3K 5% 1/4w	R18	Allen Bradley
CB4715	Resistor, fixed 470Ω 5% 1/4w	R10, R12, R21	Allen Bradley
CB7525	Resistor, fixed 7.5K 5% 1/4w	R13	Allen Bradley
CB2725	Resistor, fixed 2.7K 5% 1/4w	R14	Allen Bradley
CB1235	Resistor, fixed 12K 5% 1/4w	R16	Allen Bradley
CB1215	Resistor, fixed 120Ω 5% 1/4w	R17, R20	Allen Bradley
CB2025	Resistor, fixed 2K 5% 1/4w	R19, R25	Allen Bradley
CB5625	Resistor, fixed 5.6K 5% 1/4w	R22	Allen Bradley
CB5635	Resistor, fixed 56K 5% 1/4w	R23	Allen Bradley
CB3635	Resistor, fixed 36K 5% 1/4w	R24	Allen Bradley
CB2415	Resistor, fixed 240Ω 5% 1/4w	R27	Allen Bradley
CB5615	Resistor, fixed 560Ω 5% 1w	R28	Allen Bradley
CB2425	Resistor, fixed 2.4K 5% 1/4w	R30	Allen Bradley
CB6805	Resistor, fixed 68K 5% 1/4w	R32	Allen Bradley
CB4735	Resistor, fixed 47K 5% 1/4w	R33	Allen Bradley
CB9125	Resistor, fixed 9.1K 5% 1/4w	R34	Allen Bradley
CB2015	Resistor, fixed 200Ω 5% 1/4w	R35, R36	Allen Bradley
TGS50	Capacitor, 0.05 uf 50 vdc	C1, C2	Sprague
CB5625	Resistor, fixed 5.6K 5% 1/4w	R1, R5	Allen Bradley
CB5115	Resistor, fixed 510Ω 5% 1/4w	R2, R4	Allen Bradley
CB1045	Resistor, fixed 100K 5% 1/4w	R3	Allen Bradley
3N138	Mosfet	Q1	RCA
HRN1030	Mosfet	Q2	Hughes

Table 6-1. Replacement Parts List (Cont)

Part No.	Description	Ref Des	Mfg
Model 206 - Card No. 2			
DM15-102J	Capacitor, 1000 pf 500 vdc 5%	C1	Elmenco
822AZ-4.5-25	Capacitor, variable 4.25 pf	C2	Centralab
DM10-121J	Capacitor, 120 pf 5% 500 vdc	C3	Elmenco
DM10-100J	Capacitor, 10 pf 5%	C4	Elmenco
DM10-300J	Capacitor, 33 pf 5%	C5	Elmenco
TGS-50	Capacitor, 0.05 uf	C6, C7	Sprague
1N750	Diode, zener	CR1	IRC
1N759	Diode	CR2, CR7	IRC
1N4009	Diode	CR3, CR4, CR5, CR6, CR8	GE
1N753	Diode, Zener	CR9	IRC
572	Jack, phono	J1, J2, J3	Keystone
2N4126	Transistor	Q1, Q2, Q3	Motorola
SN72710N	Circuit, Int.	A1	Texas Inst.
CB4715	Resistor, fixed 470Ω 5% 1/4w	R1	Allen Bradley
CB3925	Resistor, fixed 3.9K 5% 1/4w	R2, R7	Allen Bradley
CB1125	Resistor, fixed 1.1K 5% 1/4w	R3, R5	Allen Bradley
CB1035	Resistor, fixed 10K 5% 1/4w	R4	Allen Bradley
CB2015	Resistor, fixed 200Ω 5% 1/4w	R6	Allen Bradley
CB2425	Resistor, fixed 2.4K 5% 1/4w	R8	Allen Bradley
CB4725	Resistor, fixed 4.7K 5% 1/4w	R9	Allen Bradley
CB1225	Resistor, fixed 1.2K 5% 1/4w	R10	Allen Bradley
CB9115	Resistor, fixed 910Ω 5% 1/4w	R11, R13	Allen Bradley

Table 6-1. Replacement Parts List (Cont)

Part No.	Description	Ref Des	Mfg
Model 206 - Card No. 2 (Cont)			
75PR2K	Resistor, variable 2K 10% 1w	R12	Helitrim
CB1535	Resistor, fixed 15K 5% 1/4w	R14	Allen Bradley
CB1625	Resistor, fixed 1.6K 5% 1/4w	R15, R16	Allen Bradley
CB6835	Resistor, fixed 68K 5% 1/4w	R17	Allen Bradley
CB3315	Resistor, fixed 330Ω 5% 1/4w	R18	Allen Bradley
CB2225	Resistor, fixed 2.2K 5% 1/4w	R19	Allen Bradley
Model 206 - Card No. 3			
SN7400N	Circuit, Int	A1, A2, A3, A4, A5, A7, A8, A9, A10	Texas Inst.
SN7410N	Circuit, Int	A6	Texas Inst.
SN7470N	Circuit, Int	A11	Texas Inst.
DM15-681J	Capacitor, 680 pf 5%	C1	Elmenco
TGS-50	Capacitor, 0.05 uf	C2	Sprague
192P10392	Capacitor, 0.01 uf 200 vdc	C3	Sprague
1N4009	Diode	CR1	GE
CB2025	Resistor, fixed 2K 5% 1/4w	R1, R2, R3, R4, R5	Allen Bradley
Model 206 - Card No. 4			
SN7400	Circuit, Int	A1	Texas Inst.
SN7410	Circuit, Int	A2	Texas Inst.
SN72710N	Circuit, Int	A3	Texas Inst.
192P33292	Capacitor, 0.0033 uf	C1	Sprague
TGS-50	Capacitor, 0.05 uf	C2, C3	Sprague

Table 6-1. Replacement Parts List (Cont)

Part No.	Description	Ref Des	Mfg
Model 206 - Card No. 4 (Cont)			
1N752	Diode, zener	CR1	IRC
1N759	Diode, zener	CR2	IRC
CB4715	Resistor, fixed 470Ω 5% 1/4w	R1	Allen Bradley
CB3025	Resistor, fixed 3K 5% 1/4w	R2	Allen Bradley
CB6225	Resistor, fixed 6.2K 5% 1/4w	R3	Allen Bradley
CB2225	Resistor, fixed 2.2K 5% 1/4w	R4	Allen Bradley
CB1025	Resistor, fixed 1K 5% 1/4w	R5, R6	Allen Bradley
CB1135	Resistor, fixed 11K 5% 1/4w	R7	Allen Bradley
CB1225	Resistor, fixed 1.2K 5% 1/4w	R8	Allen Bradley
Model 206 - Card No. 5			
SN7470N	Circuit, Int	A1, A2 A6, A7	Texas Inst.
SN7490N	Circuit, Int	A3, A4, A5	Texas Inst.
SN7400N	Circuit, Int	A8, A9	Texas Inst.
TGS-50	Capacitor, 0.05 uf	C1	Sprague
CB5115	Resistor, fixed 510Ω 5% 1/4w	R1, R2	Allen Bradley
CR19A/U	Crystal 3 mHz	Y1	MIL Type
8000DG2	Socket Assy, Crystal		Augat
SN7490N	Circuit, Int	A10	Texas Inst.
Model 206 - Card No. 6			
DM15-102J	Capacitor 1000 pf	C1	Elmenco
192P10392	Capacitor 0.01 uf	C2, C3	Sprague
TGS-50	Capacitor 0.05 uf	C4	Sprague

Table 6-1. Replacement Parts List (Cont)

Part No.	Description	Ref Des	Mfg
Model 206 - Card No. 6 (Cont)			
DM10-330J	Capacitor, 33 pf	C5	Elmenco
1N4009	Diode	CR1, CR2, CR3, CR4, CR5	GE
1N758A	Diode, zener	CR6	IRC
MPS706	Transistor	Q1, Q2, Q3, Q4, Q5	Motorola
CB2425	Resistor, fixed 2.4K 5% 1/4w	R1, R5, R9, R13	Allen Bradley
CB1235	Resistor, fixed 12K 5% 1/4w	R21	Allen Bradley
CB7535	Resistor, fixed 75K 5% 1/4w	R2, R6, R10, R14	Allen Bradley
CB4325	Resistor, fixed 4.3K 5% 1/4w	R3, R7, R11, R15	Allen Bradley
CB3315	Resistor, fixed 330Ω 5% 1/4w	R4, R8, R12, R16	Allen Bradley
CB5125	Resistor, fixed 5.1K 5% 1/4w	R17, R18, R19	Allen Bradley
CB9125	Resistor, fixed 9.1K 5% 1/4w	R20	Allen Bradley
CB3925	Resistor, fixed 3.9K 5% 1/4w	R22	Allen Bradley
SO-16	Transformer	T1, T2	UTC
Model 206 - Card No. 7			
SN7400N	Circuit, Int	A1, A2, A3 A4, A7	Texas Inst.
SN7420N	Circuit, Int	A5, A6	Texas Inst.
TGS-50	Capacitor, 0.05 uf	C1	Sprague

Table 6-1. Replacement Parts List (Cont)

Part No.	Description	Ref Des	Mfg
Model 206 - Card No. 13 and 14			
SN7400N	Circuit, Int	A1, A2, A3, A4, A7, A8, A9, A10, A11	Texas Inst.
SN7420N	Circuit, Int	A5, A6	Texas Inst.
TGS-50	Capacitor, 0.05 uf	C1	Sprague
Model 206 - Card No. 8, 10, 11, 12 and 15			
SN7400N	Circuit, Int	A1, A2, A3, A4, A6, A7, A8, A9, A11, A12, A13, A14, A15	Texas Inst.
SN7420N	Circuit, Int	A5, A10	Texas Inst.
TGS-50	Capacitor, 0.05 uf	C1	Sprague
Model 206 - Card No. 9			
SN7490N	Circuit, Int	A1, A2, A3, A4, A5	Texas Inst.
TGS-50	Capacitor, 0.05 uf	C1	Sprague
Model 206 - Card No. 16			
SN7490N	Circuit, Int	A1, A2, A3, A4	Texas Inst.
TGS-50	Capacitor, 0.05 uf	C1	Sprague
5 Volt Power Supply			
P6376	Transformer	T1	Stancor
505220201	Capacitor	C1, C2	Sangamo
2N3054	Transistor	Q1	RCA
K39C10K	Capacitor, 39 uf 50 vdc	C3	Kemet

Table 6-1. Replacement Parts List (Cont)

Part No.	Description	Ref Des	Mfg
	5 Volt Power Supply (Cont)		
PC1-3E1	Diode	D1 thru D4	Pwr Comps Inc
1N755	Diode, zener 7.5 v	D5	IRC
1N749	Diode, zener 4.3 v	D6	IRC
2N5189	Transistor	Q2	RCA
2N3391A	Transistor	Q3	GE
CB4715	Resistor, fixed 470Ω5% 1/4w	R1, R2	Allen Bradley
RN60C3010F	Resistor, film 301Ω1% 1/8w	R3	Ward Leonard
RN60C1001F	Resistor, film 1K 1% 1/8w	R4	Ward Leonard
CB1025	Resistor, fixed 1K 5% 1/4w	R5	Allen Bradley
	Selected	R6	
	Dual Power Supply		
505-2202-01	Capacitor	C1, C2	Sangamo
2N3740	Transistor	Q1	Motorola
2N3054	Transistor	Q4	RCA
U6E7741393	Circuit, Int	A1, A2	Fairchild
MTV100DN50	Capacitor	C3, C4	Mallory
CLM-1	Diode	D1, D2, D3 D4	Power Components Inc.
1N965	Diode, Zener	D5, D6	IRC
1N751A	Diode, Zener	D11	IRC
2N5189	Transistor	Q2, Q6	RCA
2N4037	Transistor	Q3	RCA
2N3638	Transistor	Q5	Fairchild
*Used on Model 206A only.			

MP MASTER
MA22486